269

PAGE'S WEEKLY.—September 29, 1905. Thin Paper Copy for Circulation Abroad.

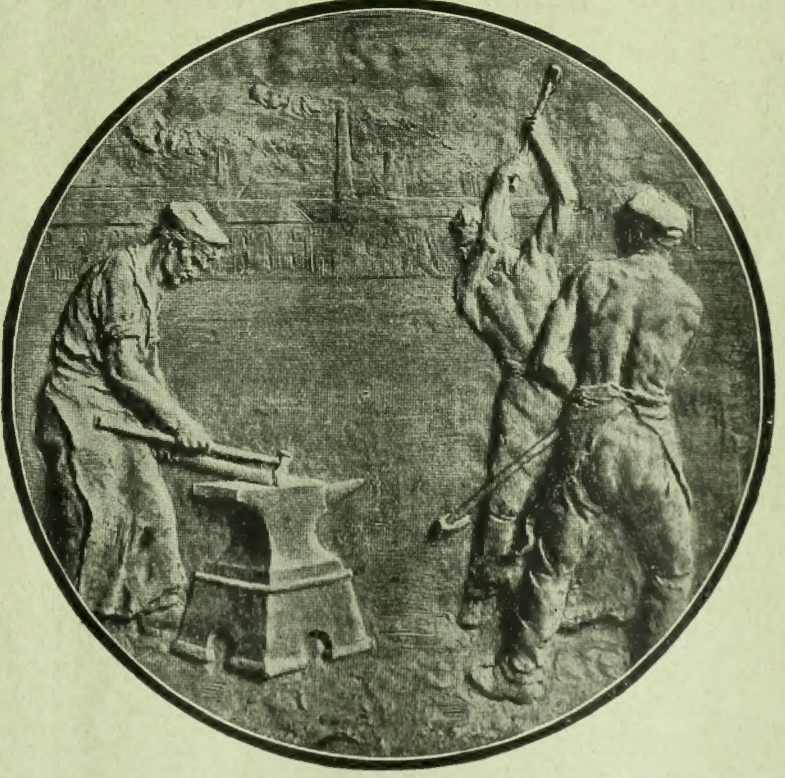
NO. 55. VOL. 7.

SIXPENCE.
(REGISTERED AS A NEWSPAPER.)

FRIDAY,
SEPTEMBER 29, 190

OCT 2 1905
OF TORONTO

PAGE'S WEEKLY



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PAGE'S WEEKLY Miscellaneous

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Three ,, ,,	30 ft. ,, 8 ft. 6 in.	,, 120 lb.
One ,, ,,	30 ft. ,, 8 ft. 6 in.	,, 100 lb.
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One Cornish ,,	20 ft. ,, 5 ft.	,, 100 lb.

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JOSEPH BOOTH BROS., LTD., RODLEY, LEEDS. See next week.

LIFTING MACHINERY.

THOS. W. WARD, ALBION WORKS, SHEFFIELD. See Page 17.

MACHINE TOOLS.

THE SHANNON, LTD., Ropemaker St., London, E.C. See Page 69.

OFFICE APPLIANCES.

Have you seen our Advertisement on page ~~69~~ 48 ? A glance at it may save you £500 per annum.—ED. BENNIS & CO., Ltd., BOLTON.

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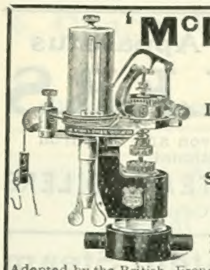

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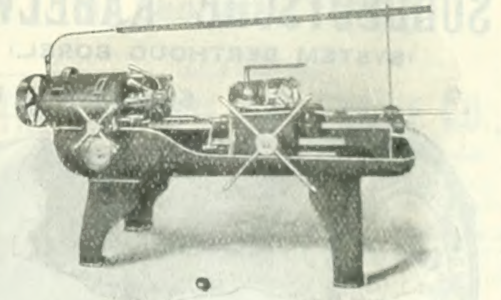

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PAGE'S WEEKLY Miscellaneous

IT is not only in America that engineers need to organise an efficient advertising campaign. The necessity is as great, or more so, on this side. To meet such conditions the British Advertiser Service Bureau, of Queen Anne's Chambers, Westminster, specialises in advertising for engineers. They undertake to conduct a firm's advertising in the same way as would a department of the concern. They prepare copy, draft booklets, circulars, &c., but differ from an advertising agency in the important feature that they do no placing; rendering only service for which they are paid by the advertiser, they leave the actual purchasing of space and printed matter in the client's hands. Several large engineering concerns have already availed themselves of the facilities thus afforded, and others have signified their intention of doing so when existing arrangements expire.

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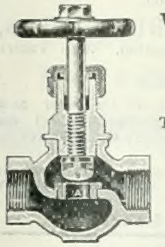

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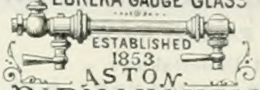

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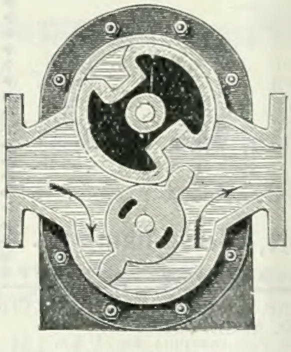

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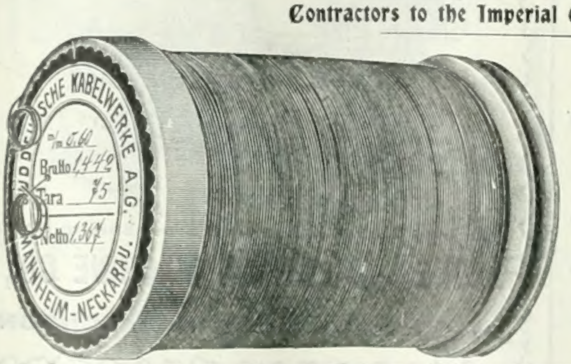

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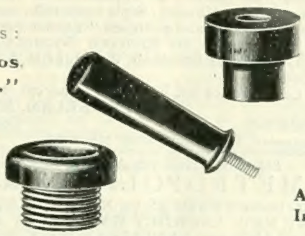

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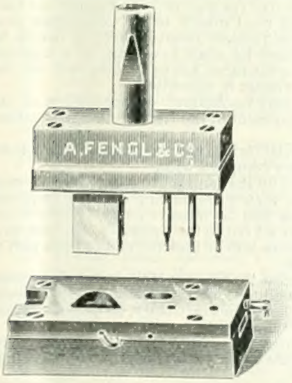

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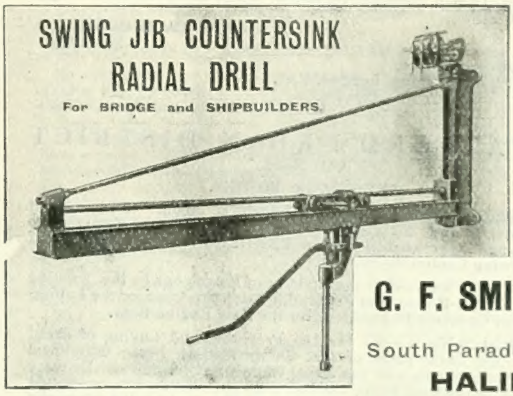

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SURREY STREET, W.C.

PAGE'S WEEKLY Contracts

CONTRACTS.

THE MADRAS RAILWAY COMPANY

are prepared to receive by Twelve o'clock noon on Monday, October 2nd, TENDERS for the supply and delivery, free on board, of ZINC SHEETS, TOOL STEEL, BOLTS and NUTS, MOULDERS' TOOLS, TUBE EXPANDERS, SCREW TAPS, AUGERS, TWIST DRILLS, SPLIT COTTERS, SAWS, CARRIAGE LOCKS, WINDOW CATCHES and HINGES, GAUGE GLASS, PROTECTORS, HEAD LAMPS, ENAMELLED IRON COMMODES, FIREBRICKS, CARBORUNDUM WHEELS, PLATE GLASS, STEAM PACKING, CURLED HORSEHAIR, PAINT BRUSHES, MACHINE BELTING, RUBBER PADS, TRANSFERS, and NON-CONDUCTING COMPOSITION, as per Specifications to be seen at the Company's Offices.

Tenders to be delivered in sealed envelopes, addressed to the undersigned, endorsed "Tender for Loco. Stores," Part I. (or Part II., as the case may be).

The Directors do not bind themselves to accept the lowest or any Tender.

A charge (which cannot be refunded) will be made for each copy of the Specification.

W. H. COLE,
Secretary.

1, Broad Street Place,
Finsbury Circus, London, E.C.,
September 14th, 1905.

WATFORD URBAN DISTRICT COUNCIL.

SEWERAGE WORKS.

The Watford Urban District Council is about to carry out DRAINAGE and SEWERAGE WORKS for the Cassiobridge District, and is prepared to receive TENDERS for the Execution of the following Contracts—viz.:—

CONTRACT No. 1.—For the Building of Extensions to the Existing Engine-Houses and Excavating Deep Trenches for the Laying of Concrete Foundations for the New Engine Beds.

CONTRACT No. 2.—(*a*) For the Providing and Laying of about 1,930 lineal yards of 4-in. Compressed-Air Pipe; 250 lineal yards of 9-in. and 640 lineal yards of 12-in. Sewage Delivery Pipe (all Cast Iron), together with the Valves, &c., connected therewith; and (*b*) Supplying and Erecting by the Licensees and Manufacturers of Patented Apparatus for the Extension of the Existing Air-Compressing and Sewage-Ejecting Plant, on the Shone Hydro-pneumatic System.

The Plans, Sections, Specifications, Quantities, and Forms of Tender may be obtained at the Office of Mr. DAVID WATERHOUSE, C.E., the Surveyor to the Urban District Council of Watford; and from the Engineers, Messrs. **SHONE AND AULT**, 47, Victoria Street, Westminster, S.W., on deposit of Three Guineas, which will be returned on receipt of a *bona fide* Tender fulfilling the conditions to be observed in tendering.

Sealed Tenders, endorsed "Cassiobridge Sewerage Works—Contract No. ——," to be sent to the undersigned on or before Wednesday, October 4th, 1905.

The Council do not bind themselves to accept the lowest or any Tender, and the acceptance of any Tender will be subject to the sanction of the Local Government Board being obtained to a loan for carrying out the Works.

H. MORTEN TURNER,
Clerk to the Council.

Council Offices, Watford,
August 30th, 1905.

METROPOLITAN WATER BOARD.

TENDERS FOR STEAM ENGINE AND PUMPS.

The Metropolitan Water Board invite TENDERS for PROVIDING and FIXING a STEAM ENGINE, with LIFT and FORCE PUMPS (capable of delivering 500,000 gallons of water in 24 hours), on the Board's land at the Hill Park Estate, Westerham, Kent.

Forms of Tender and Contract, with Specification and Drawings, may be obtained on application to the District Engineer, at the Board's Offices, Brookmill Road, Deptford, S.E., on production of an official receipt for the sum of Five Guineas, which sum must first be deposited with the Comptroller at the Board's Central Offices, Savoy Court, Strand, W.C., and which will be returned on receipt of a *bona fide* Tender.

Such application must be made between the hours of 10 and 4 (except on Saturdays) on and after Friday, the 1st September.

Tenders, endorsed "Tender for Pumping Engine, Westerham, Kent," must be sent in sealed envelopes to the undersigned not later than 10 a.m. on Monday, October 2nd, 1905.

The Board do not bind themselves to accept the lowest or any Tender.

(Signed) A. B. PILLING,
Clerk of the Board.

Office of the Board,
Savoy Court, Strand, W.C.,
August 29th, 1905.

THE COUNTY COUNCIL OF MIDDLESEX.

TO CONTRACTORS.

The Light Railways and Tramways Committee of the County Council of Middlesex invite TENDERS for the WORK and MATERIALS required in the Construction of the Permanent Way (for electric traction), Bridge Work, Road Widenings, &c., for:—

CONTRACT No. 14.

Railway No. 2 (Order 1901).—A line of double track (with cross-overs, contingent works, &c.), to be laid along Bounds Green Road in the district of Wood Green, and High Road in the district of Southgate, in the County of Middlesex, to a length of 1 mile, 5 furlongs, 1 chain, or thereabouts.

The Plans, Conditions of Contract, Specifications of Works, &c., for this Contract may be seen, and Schedules of Quantities obtained by intending contractors (on payment of £10, which will be returned on receipt of a *bona fide* Tender) on application at my offices between office hours on and after Monday, September 18th, 1905.

Tenders, properly sealed and endorsed "Tender for Light Railway, No. 2," to be delivered to Sir RICHARD NICHOLSON, Clerk of the County Council, Middlesex Guildhall, Westminster, S.W., on or before October 4th, 1905.

The County Council does not bind itself to accept the lowest or any Tender.

H. T. WAKELAM, M.Inst.C.E.,
County Engineer.

Middlesex Guildhall,
Westminster, S.W., September 7th, 1905.

TO ENGINEERS AND OTHERS.

THE METROPOLITAN ASYLUMS

BOARD invite TENDERS for NEW BOILERS and BOILER HOUSE PLANT, NEW LAUNDRY MACHINERY and REVISIONS to LAUNDRY PLANT, also NEW STEAM MAIN, &c., at the Eastern Hospital, Homerton, N.E., in accordance with Drawings and Specification prepared by Mr. W. T. HATCH, M.I.C.E., M.I.M.E., Engineer-in-Chief.

Drawings, Specification, Conditions of Contract, and Form of Tender, may be inspected at the office of the Board, Embankment, E.C., on and after Wednesday, September 13th, 1905, and can be obtained upon payment of a deposit of £2.

The amount of the deposit will be returned only to persons who have sent in *bona fide* Tenders and returned Drawings and Specification in accordance with the regulations.

Tenders, addressed as noted on the form, must be delivered at the office of the Board not later than 10 a.m. on Tuesday, October 3rd, 1905.

By order,
T. DUNCOMBE MANN,
Clerk to the Board.

September 6th, 1905.

COUNTY OF LONDON.—TO ELECTRIC CABLEMAKERS.

The London County Council invites TENDERS for the manufacture and laying of

(*a*) 56 miles LOW-TENSION, LEAD-COVERED, PAPER-INSULATED CABLES, 20 miles DRY-CORE TELEPHONE CABLES, CAST-IRON FEEDER PILLARS, &c., &c.

(*b*) 24 miles EXTRA HIGH-TENSION 3-CORE, LEAD-COVERED, PAPER-INSULATED CABLES, &c.

Persons desiring to submit Tenders may inspect the Drawings and obtain the Specifications, Bills of Quantities, Forms of Tender, and other particulars at the County Hall, Spring Gardens, S.W., upon payment to the Cashier of the Council of the sum of Two Pounds for each Section. This amount will, after the Council or its Committee shall have come to a decision upon the Tenders received, but not before, be returned to the Tenderer, provided he shall have sent in a *bona fide* Tender and not have withdrawn the same, but in no case will the fee be returned unless a *bona fide* Tender is submitted.

Full particulars of the Work may be obtained on application at the County Hall previously to the payment of the fee for the Specification, &c.

Tenders must be upon the official forms, and the printed instructions contained therein must be strictly complied with.

The Contractors will be bound by the contract to pay to all workmen (except a reasonable number of legally bound apprentices) employed by them wages at rates not less and to observe hours of labour not greater than the rates and hours set out in the Council's list, and such rates of wages and hours of labour will be inserted in and form part of the contract by way of schedule.

Each Tender is to be delivered at the County Hall, in a sealed cover, addressed to the Clerk of the London County Council, Spring Gardens, S.W., and marked "Tender for Low-Tension Cables, &c.," and "Tender for High-Tension Cables, &c.," respectively.

No Tender will be received after 10 a.m. on Tuesday, October 3rd, 1905. Any Tender which does not comply with the printed instructions for Tender may be rejected.

The Council does not bind itself to accept the lowest or any Tender, and it will not accept any Tender which is not strictly in accordance with the Specification, or the Tender of any person or firm who shall on any previous occasion have withdrawn a Tender after the same had been opened unless the reasons for the withdrawal were satisfactory to the Council.

G. L. GOMME,
Clerk to the London County Council.

County Hall, Spring Gardens, S.W.,
September 14th, 1905.

PAGE'S WEEKLY Contracts and Appointments Open

URBAN DISTRICT OF HORSFORTH.

WATERWORKS.

The Urban District Council of Horsforth invite **TENDERS** for the CONSTRUCTION and ERECTION of a SUCTION GAS PRODUCING PLANT and GAS ENGINE capable of producing 32 Brake Horse-power, for the purpose of driving a Bore Hole Pump for the Horsforth Waterworks at Scotland Lane, Horsforth.

A plan of the general arrangement of the machinery can be seen, and copies of the General Conditions, Specification, and Tender can be obtained at the offices of the Engineer, Mr. E. J. Silcock, M.Inst.C.E., 10, Park Row, Leeds.

Sealed Tenders, endorsed "Gas Engine," must be delivered to the undersigned not later than noon, Monday, October 16th, 1905.

The Council do not bind themselves to accept the lowest or any Tender.

By order,
ROBT. R. JONES,
Clerk to the Council.

Council Offices,
Horsforth, near Leeds,
September 13th, 1905.

METROPOLITAN RAILWAY COMPANY. STORES CONTRACT.

The Directors of the Metropolitan Railway Company are prepared to receive **TENDERS** for the SUPPLY of GENERAL STORES during Twelve Months ending October 31st, 1906.

Manufacturers and others desirous of tendering should apply to the undersigned on or after September 26th, 1905, for a form or forms under the following numbers :—

No.
1. Acids, Chemicals, Disinfectants, &c.
2. Asbestos and other Packings.
3. Axles, Tyres, Springs, Forgings, Steel, Files, &c.
4. Bolts, Nuts, Rivets, Spikes, Washers, Iron Fencing, &c.
5. Boots and Clogs.
6. Brooms, Brushes, Baskets, Mats, and Sponges.
7. Canvas, Calico, Rope, Twine, Sewing Threads, &c.
8. Carriage Handles, Hinges, Locks, &c.
9. Carriage Trimmings, Hair Rugs, Leather Cloth, &c.
10. Castings, Iron and Malleable.
11. Cement, Bricks, Pipes, Paving, Slates, Broken Granite, &c.
12. Cocks, Valves, Sanitary Fittings, Gas Gauges, Gas Burners, &c.
13. Coke, Gas.
14. Colours, Varnishes, Putty, Polishes, Gold Leaf, &c.
15. Copper, Brass, Solder, Spelter, Antimony, &c.
16. Cotter, Motion and Joint Pins, Studs, &c.
17. Crucibles and Plumbago.
18. Electric Lamps, Carbons, Ebonite Fuses, &c.
19. Electric Wire Casings and Wood Wool.
20. Electric Wires and Cables.
21. Felt (Roofing), &c.
22. Fish-plates.
23. Fog Signals (Detonating).
24. Gas and Steam Tubes and Fittings, Steel Boiler Tubes, &c.
25. Gilt Mouldings.
26. Glass Lenses, Chimneys, Bends, Gauge Tubes, &c.
27. Glass : Plate, Sheet, Coloured, &c.
28. Handles, Hammer, &c., Coupling Poles, Ladders, Scaffolding, Barrows, &c.
29. Incandescent Gas Fittings, Mantles, &c.
30. India-rubber (General), Brake Hose, Waterproof Coats, &c
31. Iron and Mild Steel Bars, Plates, &c.
32. Ironmongery : Kettles, Saucepans, Enamelled Reflectors, &c.
33. Ironmongery : Locks, Hinges, Screws, &c.
34. Keys, Trenails, Wood Fencing, &c.
35. Lamps, Tinware, Plated Reflectors, &c.
36. Lead : Pig, Pipe, Sheet, White, Red.
37. Leather Hides and Skins (including Chamois).
38. Meters, Gas and Water.
39. Nails, Tacks, Panel Pins, Chain, &c.
40. Oils, Burning and Lubricating, and Burning Naphtha.
41. Pipes : Iron Socket and Rain-water, Ranges, &c.
42. Sand, Gravel, and Picked Flints.
43. Signal Ironwork, Switch Boxes, Wire Pulleys, &c.
44. Soap, Grease, Tallow, Turpentine, Spirit, Tar, Pitch, &c.
45. Telegraph Fittings, Battery Jars, Zincs, Insulators, &c.
46. Timber : Deals, creosoted, Telegraph Poles, Jarrah, Sawdust, &c.
47. Timber : Teak, Mahogany, Oak, Ash, Telegraph Arms, &c.
48. Tools : Shovels, Hammers, Picks, Saws, Augers, &c.
49. Transfers and Transparencies.
50. Waste (Cotton), Flannel, Sponge, Cloths, Towels, Flags, and other soft goods.
51. Waterproof Oilskins, Tarpaulins, &c.
52. Whiting, Glue, Emery Cloths, Matches, &c.
53. Wire : Iron, Galvanised Strand, &c.
54. Zinc, Tin-plates, Galvanised Sheets and Holloware, Sieves, &c.

After the forms have been obtained, samples and patterns of articles and goods may be seen at the office of the Company's Storekeeper, adjoining Neasden Station, N.W., from Monday, October 2nd, to Saturday, October 7th, both days inclusive.

Tenders, on the forms supplied by the Company only, and endorsed "Tender for ....," must reach the Secretary not later than 10 a.m. on Monday, October 9th.

The Directors do not bind themselves to accept the lowest or any Tender.

R. H. SELBIE, Secretary.

Secretary's Office : 32, Westbourne Terrace, London, W.

URBAN DISTRICT OF HORSFORTH.

WATERWORKS.

The Urban District Council of Horsforth invite **TENDERS** for the CONSTRUCTION and ERECTION of a BOREHOLE PUMP, capable of lifting 9,000 gallons per hour from a depth of 350 ft., for the Horsforth Waterworks, at Scotland Lane, Horsforth.

A plan of the general arrangement of the machinery can be seen, and copies of the General Conditions, Specification, and Tender can be obtained at the offices of the Engineer, Mr. E. J. Silcock, M.Inst.C.E., 10, Park Row, Leeds.

Sealed Tenders, endorsed "Borehole Pump," must be delivered to the undersigned not later than noon, Monday, October 16th, 1905.

The Council do not bind themselves to accept the lowest or any Tender.

By order,
ROBERT R. JONES,
Clerk to the Council.

Council Offices,
Horsforth, near Leeds,
September 13th, 1905.

PONTYPRIDD URBAN DISTRICT COUNCIL.

The Urban District Council of Pontypridd are prepared to receive **TENDERS** for the following :—

ALTERATIONS TO EXISTING BATTERY-ROOM.—Section E.

Specifications and Quantities, General Conditions, and Forms of Tender may be obtained on and after Friday, September 22nd, 1905, at the Offices of the Consulting Engineer, Mr. Reginald P. Wilson, 66, Victoria Street, Westminster, on payment of a sum of Three Guineas.

This sum is required as a deposit, and will, after the Council shall have entered into a contract upon the Tenders received, but not before, be returned to the Tenderer, provided that he shall have sent in a *bona fide* Tender and shall not have withdrawn the same. In any other case this deposit will be forfeited.

The Tenders must be sent in on the official form, and all instructions contained therein must be complied with.

All Tenders (endorsed "Section E—Buildings") must be addressed to the Clerk of the Pontypridd Urban District Council, and must be delivered at the District Council Offices, Pontypridd, not later than 12 noon on Saturday, October 7th, 1905.

The Council do not bind themselves to accept the lowest or any Tender.

J. COLENSO JONES,
Clerk to the Council.

District Council Offices, Pontypridd,
September, 1905.

BOMBAY, BARODA, AND CENTRAL INDIA RAILWAY COMPANY.

The Directors are prepared to receive up to noon on Tuesday October 3rd, **TENDERS** for the SUPPLY of the following STORES viz :—

Class A.

1. Brass Boiler Tubes.
2. Gas Piping.
3. Metals.
4. Miscellaneous Tools and Stores.
5. Pig Iron.
6. Red and White Lead.
7. Spiral and Volute Springs.
8. Steel Boiler Tubes.
9. Steel Plates for Boilers.

Class B.

1. Bunting, Canvas, &c.
2. Copper Fire-box Plates.
3. Firebricks.
4. Paints, &c.
5. Weldless Hydraulic Steel Tubes.

Tenders must be made on forms, copies of which, with Specifications, can be obtained at these offices on payment as follows : For Class A, 21s. each, and for Class B, 10s. 6d. each (which will not be returned).

The Directors do not bind themselves to accept the lowest or any Tender.

T. W. WOOD, Secretary.

Offices : Gloucester House, Bishopsgate Street Without, London,
September 15th, 1905.

APPOINTMENTS OPEN.

NEW ZEALAND.—The Technical Education Board of Wellington, New Zealand, invite applications for the appointment of INSTRUCTOR in ENGINEERING. Salary, £300 and £40 passage allowance.—For further particulars, and for forms on which the application must be made, apply to the HIGH COMMISSIONER FOR NEW ZEALAND, 13, Victoria Street, London, S.W.

EBBW VALE URBAN DISTRICT COUNCIL. PUBLIC WORKS INSPECTOR.

The Ebbw Vale Urban District Council require an INSPECTOR thoroughly experienced in Waterworks Construction, Masonry, Concrete, Earthworks, and Puddle at a salary of £2 10s. per week.

Only men of good experience in this class of work need apply.

Applications, accompanied by two copies of recent testimonials (enclosed in a sealed envelope), endorsed on the outside "Inspector," should be delivered at my office not later than Saturday, October 7th, 1905.

Dated this 20th day of September, 1905.
District Council Offices, Ebbw Vale.

THO. HUGHES,
Clerk.

BUYERS' DIRECTORY.

NOTE.—*The display advertisements of the firms mentioned under each heading can be found readily by reference to the Alphabetical Index to Advertisers on pages* 35, 37, 38, *and* 40.

In order to assure fair treatment to advertisers, each firm is indexed under its leading speciality ONLY.

Advertisers who prefer, however, to be entered under two or more different sections can do so by an annual payment of 5s. *for each additional section.*

Advertisers' Service Bureau.
British Advertiser Service Bureau, Queen Anne's Chambers, Westminster, S.W.

Artesian Well Machinery.
John Z. Thom, Patricroft, Manchester.

Belting.
Binney & Son, Catherine Street, City Road, London, E.C
Cort, Arthur, & Co., Camberwell, London, S.E.
Fleming, Birkby & Goodall, Ltd., West Grove, Halifax.
Gilmour, W. & O., St. John's Hill, Edinburgh.

Boilers.
Clayton, Son & Co., Ltd., Leeds City Boiler Works, Leeds.
Grantham Boiler and Crank Co., Ltd., Grantham.
Hartley & Sugden, Ltd., Halifax.
Thompson, John, Wolverhampton.

Boilers (Water-tube).
Babcock & Wilcox, Ltd., Oriel House, Farringdon Street, London, E.C.
Stirling Boiler Co., Ltd., Motherwell, N.B.

Bolts, Nuts, Rivets, etc.
Herbert W. Periam, Ltd., Floodgate Street Works, Birmingham.
T. D. Robinson & Co., Ltd., Derby.

Books.
Griffin, Charles, & Co., Exeter Street, Strand, W.C.
New Zealand Mines Record, Wellington, New Zealand.
Spon, E. & F. N., 125, Strand, W.C.

Boring Machines.
Asquith, William, Ltd., Well Road Works, Halifax.
Niles-Bement-Pond Co., 23-25, Victoria Street, London, S.W.

Case-Hardening Compounds.
Hy. Miller & Co., Millgarth Works, Leeds.

Castings.
Ashmore, Benson, Pease & Co., Ltd., Stockton-on-Tees.

Catalogues, Printing, &c.
Atlantic Press, Ltd., Weymouth Street, Manchester.
Spottiswoode Advertising Agency, Clun House, Surrey Street, Strand, W.C.
Stafford, Arthur, & Co., Denton, Manchester.

Chucks.
Fairbanks Co., 78-80, City Road, London, E.C.

Cisterns, Tanks, &c.
Ashmore, Benson, Pease & Co., Ltd., Stockton-on-Tees.
F. A. Keep, Juxon & Co., Barn Street, Birmingham.

Clutches (Friction).
David Bridge & Co., Castleton Ironworks, Rochdale, Lancashire.

Coke Oven Expert.
Mallmann, P. J., 110-118, Victoria Street, S.W.

Colliery Plants.
Graham, Morton & Co., Ltd., Leeds.

Condensing Plant.
Benn, Sykes, Haslingden, near Manchester.
Concentric Condenser, Ltd., 23, Northumberland Avenue, London, W.C.
Mirrlees-Watson & Co., Ltd., Glasgow.

Consulting Engineers.
Gibbs, John, & Son, 80, Juke Street, Liverpool.
G. H. Hughes, A.M.I.M.E., 19, Old Queen Street, Westminster, S.W.
Melville & Macalpine, 615, Walnut Street, Philadelphia, Pa., U.S.A

Continental Railway Arrangements.
Northern Railway of France.
South Eastern & Chatham Railway Co.

Conveying and Elevating Machinery.
Adolf Bleichert & Co., Leipzig-Gohlis, Germany.
Fraser & Chalmers, Ltd., 3, London Wall Buildings, London, E.C.
Temperley Transporter Co., 72, Bishopsgate Street Within, London, E.C.

Coverings (Boiler).
Magnesia Coverings, Ltd., Washington Station, co. Durham.

Cranes, Travellers, Winches, etc.
Joseph Booth & Bros. Ltd, Rodley, Leeds.
Thomas Broadbent & Sons, Ltd., Huddersfield.
Niles-Bement-Pond Co., 23-25, Victoria Street, London, S.W.

Cranks.
Clarke's Crank & Forge Co., Ltd., Lincoln, England.

Cutters (Milling).
Pratt & Whitney Co., 23-25, Victoria Street, London, S.W.
E. G. Wrigley & Co., Ltd., Foundry Lane Works, Soho, Birmingham.

Destructors.
Heenan & Froude, 4, Chapel Walks, Manchester.
Horsfall Destructor Co., Ltd., Armley, Leeds.

Dredges and Excavators.
Delange & Cie. Mce., Hoboken, near Antwerp.
Rose, Downs & Thompson, Ltd., Old Foundry, Hull.

Drilling Machines.
Asquith, William, Ltd., Well Road Works, Halifax.
Niles-Bement-Pond Co., 23-25, Victoria Street, London, S.W.
Swift, George, Claremont Ironworks, Halifax.

Economisers.
E. Green & Son, Ltd., Manchester.

Ejectors (Pneumatic).
Hughes & Lancaster, 16, Victoria Street, London, S.W.

Electrical Apparatus.
Allgemeine Elektricitäts Gesellschaft, Berlin, Germany.
Broadbent, T. W., Victoria Electrical Works, Huddersfield.
Crypto Electrical Co., 3, Tyer's Gateway, Bermondsey Street, London, S.E.
Ebonestos Manufacturing Co., 22, Rosoman Street, London, E.C.
Gent & Co., Ltd., Faraday Works, Leicester.
Greenwood & Batley, Ltd., Albion Works, Leeds.
India Rubber, Gutta Percha, and Telegraph Works Co., Ltd., Silvertown, London, E.
Mather & Platt, Ltd., Salford Iron Works, Manchester.
Matthews & Yates, Ltd., Swinton, Manchester.
Mix and Genest, Berlin, W., Germany.
Nalder Bros. & Thompson, 34, Queen Street, London, E.C.
New Gutta Percha Co., Ltd., Dashwood House, New Broad Street, E.C.
Newton Brothers, Full Street, Derby.
Phœnix Dynamo Manufacturing Co., Bradford, Yorks.
Sturtevant Engineering Co., Ltd., 147, Queen Victoria Street, London, E.C.
Turner, Atherton & Co., Ltd., Denton, Manchester.
B. Weaver & Co. (*see* Ebonestos Manufacturing Co.), 22, Rosoman Street, Clerkenwell, London, E.C.

Engineers' Supplies.
Ahlers, Ad., Whitley Bay, near Newcastle-on-Tyne.

Engines (Gas).
Campbell Gas Engine Co., Ltd., Halifax
Soest, L., & Co., Ltd., 114-116, Victoria Street, London, S.W.

Engines (Electric Lighting).
McLaren, J. and H., Midland Engine Works, Leeds.

Engines (Locomotive).
Baldwin Locomotive Works, Philadelphia, Pa., U.S.A.
Hunslet Engine Co., Ltd., Leeds, England.
Hudswell, Clarke & Co., Ltd., Leeds, England.
McLaren, J. & H., Midland Engine Works, Leeds.

Engines (Portable).
Garrett, R., & Sons, Leiston, R.S.O., Suffolk.

Engines (Stationary).
Allis-Chalmers Co., 533, Salisbury House, Finsbury Circus, London, E.C.
Fraser & Chalmers, Ltd., 3, London Wall Buildings, London, E.C.
Garrett, R., & Sons, Leiston, R.S.O., Suffolk.
Mirrlees Watson Co., Ltd., Glasgow.

Engines (Traction).
Jno. Fowler & Co. (Leeds), Ltd., Steam Plough Works, Leeds.
Garrett & Sons, Ltd., Richard, Leiston, R.S.O., Suffolk.

Engravers.
Jno. Swain & Son, Ltd., 58, Farringdon Street, London, E.C.

Exhaust Steam Oil Separators.
Lancaster & Tonge, Ltd., Pendleton, Manchester.

Fans, Blowers.
Capel Fan Co., 13, Moseley Street, Newcastle-on-Tyne.
Davidson & Co., Ltd., "Sirocco" Engineering Works, Belfast, Ireland.
Gibbs, John & Son, 80, Juke Street, Liverpool.
James Keith & Blackman Co., Ltd., 27, Farringdon Avenue, London, E.C.
Matthews & Yates, Ltd., Swinton, Manchester.

Fire Bricks.
J. H. Sankey & Son, Ltd., Essex Wharf, Canning Town, London, E.

PAGE'S WEEKLY Weighing Machinery

BY ROYAL WARRANT TO H.M. THE KING

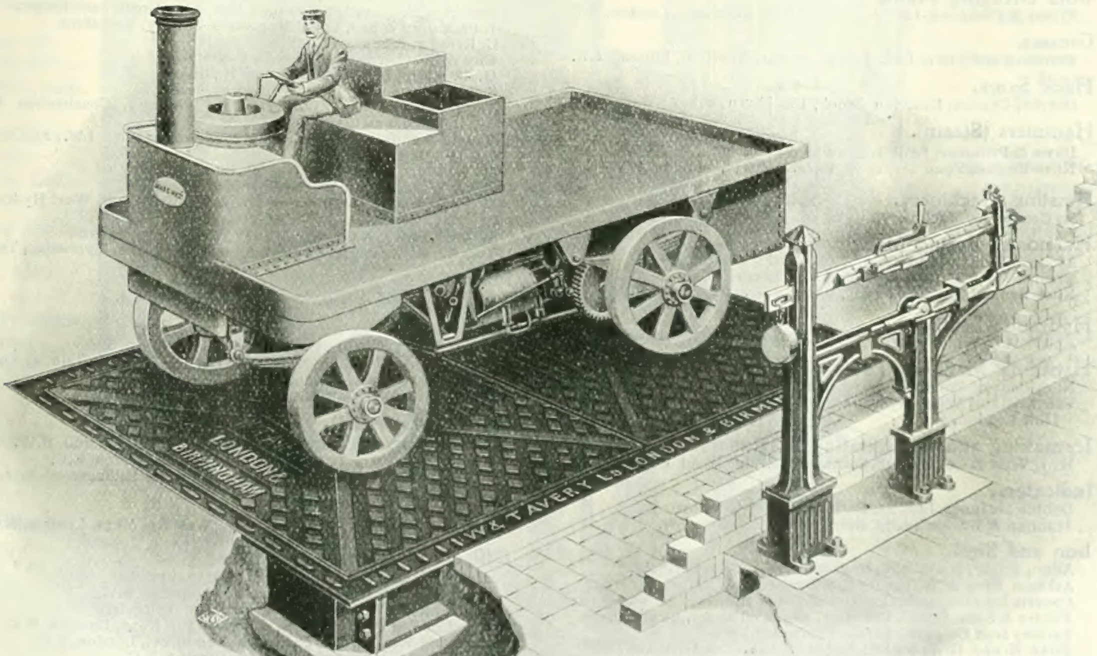
W·&·T·AVERY·LTD.

ESTD 1730

SOHO FOUNDRY

BIRMINGHAM

THE LARGEST MAKERS OF WEIGHBRIDGES IN THE WORLD


LONDON & BIRMINGHAM
W & T AVERY Ld LONDON & BIRMINGHAM

AVERY'S Specially Designed

Combination Weighbridge for Motor Wagons

For ascertaining the Weight on EACH AXLE for registering purposes; also for Weighing Motor Wagons and ordinary Road Traffic.

Buyers' Directory—(*Continued*).

Firewood Machinery.
M. Glover & Co., Patentees and Saw Mill Engineers, Leeds.

Fountain Pens.
Mabie, Todd & Bard, 93, Cheapside, London, E.C.

Forging (Drop) Plants.
Brett's Patent Lifter Co., Ltd., Coventry.

Forgings (Drop).
J. H. Williams & Co., Brooklyn, New York, U.S.A.

Furnaces.
Deighton's Patent Flue & Tube Company, Vulcan Works, Pepper Road, Leeds.
Leeds Forge Co., Ltd., Leeds.
Masons Gas Power Co., Ltd., Alma Works, Levenshulme, Manchester.

Gas Producers.
Graham, Morton & Co., Ltd., Leeds.
Masons Gas Power Co., Ltd., Alma Works, Levenshulme, Manchester.

Gauge Glasses.
J. B. Treasure & Co., Vauxhall Road, Liverpool.
Tomey, J., & Sons, Aston, Birmingham.

Gauges (Pressure, Vacuum, and Hydraulic).
Dobbie, McInnes, Ltd., 45, Bothwell Street, Glasgow.

Gearing.
Ahlers, Ad., Whitley Bay, near Newcastle-on-Tyne.
Asquith, William, Ltd., Well Road Works, Halifax.
Reid Gear Co., Linwood, near Glasgow.
Wild, M. B., & Co., Corporation Street, Birmingham.

Gold Dredging Plant.
Fraser & Chalmers, Ltd., 3, London Wall Buildings, London, E.C.

Greases.
Blumann and Stern, Ltd., Plough Bridge, Deptford, London, S.E.

Hack Saws.
Baynes, Charles, Knuzden Brook, Blackburn.

Hammers (Steam).
Davis & Primrose, Leith Ironworks, Edinburgh.
Niles-Bement Pond Co., 23-25, Victoria Street, London, S.W.

Hoisting Machinery.
See Conveying Machinery.

Horizontal Boring Machines.
Asquith, William, Ltd., Well Road Works, Halifax.
Greenwood & Batley, Albion Works, Leeds.
Niles-Bement Pond Co., 23-25, Victoria Street London, S.W.

Hydraulic Leather.
Ahlers, Ad., Whitley Bay, near Newcastle-on-Tyne.

Hydraulic Machine Tools.
Niles-Bement-Pond Co., 23-25, Victoria Street, London, S.W.
Vauxhall and West Hydraulic Engineering Co. Ltd., 23, College Hill, London, E.C.

Icemaking and Refrigerating Machinery.
H. J. West & Co., 114-118, Southwark Bridge Road, London, S.E.

Indicators.
Dobbie McInnes, Ltd., 45, Bothwell Street, Glasgow.
Hannan & Buchanan, 75, Robertson Street, Glasgow.

Iron and Steel.
Allen, Edgar, & Co. Ltd., Imperial Steel Works, Sheffield.
Askham Bros. & Wilson, Ltd., Sheffield.
Consett Iron Co., Ltd., Consett, Durham, and Newcastle-on-Tyne.
Fairley & Sons, James, Old Mint, Shadwell Street, Birmingham.
Farnley Iron Co., Ltd., Leeds. England.
Fried. Krupp, Grusonwerk, Magdeburg-Buckau, Germany.
J. Frederick Melling, 14, Park Row, Leeds, England.
Parker Foundry Co,, Derby.
Purden, John & Sons, Lambhill Forge, by Maryhill, Glasgow.
Walter Scott, Ltd., Leeds Steel Works, Leeds, England.
Gilbert Thompson & Co., 116, Victoria Street, London, S.W.

Ironwork (Constructional).
F. A. Keep, Juxon & Co., Barn Street, Birmingham.

Ironwork (Galvanised).
F. A. Keep, Juxon & Co., Barn Street, Birmingham.

Lagging Sheets.
Zeitz & Co., 21, Lime Street, London, E.C.

Lathes.
Asquith, William, Ltd., Well Road Works, Halifax.
Bradbury & Co., Ltd., Wellington Works, Oldham.
Eclipse Tool Manufacturing Co., Linwood, near Glasgow.
Leckenby, Benton, & Co., Perseverance Ironworks, Halifax.
Mitchell, D., & Co., Ltd., Central Ironworks, Lawkholme, Keighley.
Niles-Bement-Pond Co., 23-25, Victoria Street, London, S.W.
Northern Engineering Co. (1900) Ltd., King Cross, near Halifax.
Swift, George, Claremont Ironworks, Halifax.

Lathe Carriers.
Williams, J. H., & Co., Brooklyn New York, U.S.A.

Laundry Machinery.
W. Summerscales & Sons, Ltd., Engineers, Phœnix Foundry, Keighley, England.

Lifts.
Waygood & Co., Ltd., Falmouth Road, London, S.E.

Lubricants.
Blumann & Stern, Ltd., Plough Bridge, Deptford, London, S.E.
Reliance Lubricating Oil Co., The, 19 & 20, Water Lane, Great Tower Street, London, E.C.
Matthew Wells & Co., Hardman Street Oil Works, Manchester.

Machine Tools.
Asquith, William, Ltd., Well Road Works, Halifax.
George Addy & Co., Waverley Works, Sheffield.
Bateman's Machine Tool Co., Hunslet, Leeds.
Bertrams, Ltd., St. Katherine's Works, Sciennes, Edinburgh.
Bradbury & Co., Ltd., Wellington Works, Oldham.
Breuer, Schumacher & Co., Ltd., Kalk, near Cologne-on-Rhine (Germany).
Consolidated Pneumatic Tool Co., Ltd., Palace Chambers, 9, Bridge Street, Westminster, S.W.
Cunliffe & Croom, Ltd., Broughton Ironworks, Manchester.
Dean, Smith & Grace, Ltd., Keighley.
Fengl, A., & Co., Grafton Street, Altrincham.
Greenwood & Batley, Ltd., Leeds.
Jones & Lamson Machine Co., 97, Queen Victoria Street, London, E.C.
John Lang & Sons, Johnstone, near Glasgow.
Luke & Spencer, Ltd., Broadheath, Manchester.
Mitchell, D., & Co., Ltd., Central Ironworks, Lawkholme, Keighley
Jos. C. Nicholson Tool Co., City Rd. Tool Wks., Newcastle-on-Tyne.
Niles-Bement-Pond Co., 23-25, Victoria Street, London, S.W.
Noble & Lund, Ltd., Felling-on-Tyne.
Northern Engineering Co., 1900, Ltd., King Cross, near Halifax.
J. Parkinson & Son, Canal Ironworks, Shipley, Yorkshire.
C. Redman & Sons, Halifax.
Rice & Co. (Leeds), Ltd., Leeds, England.
G. F. Smith, Ltd., South Parade, Halifax.
Swift, George, Claremont Ironworks, Halifax.
Taylor and Challen, Ltd., Derwent Foundry, Constitution Hill, Birmingham.
Vauxhall and West Hydraulic Engineering Co., Ltd., 23, College Hill, London, E.C.
H. W. Ward & Co., Lionel Street, Birmingham.
T. W. Ward, Albion Works, Sheffield.
West Hydraulic Engineering Co. (see Vauxhall and West Hydraulic Engineering Co. Ltd.), 23, College Hill, London, E.C.
Winn, Charles. & Co., St. Thomas Works, Birmingham.
Yorkshire Machine Tool and Engineering Works, Liversedge, Yorks.

Marks.
Pryor, Edward, & Son, 68, West Street, Sheffield.

Metals.
Delta Metal Co., Ltd., East Greenwich, London, S.E.
Magnolia Anti-Friction Metal Co., Ltd., of Great Britain, 49, Queen Victoria Street, London, E.C.
Phosphor Bronze Co., Ltd., Southwark, London, S.E.

Metals (Perforated).
W. Barns & Son, Chalton Street, Euston Road, London, N.W.
Brown, Andrew, & Co., 110, Cannon Street, London, E.C.
Méguin, Fr., & Co., Ltd., Engineering Works, Dillingen-on-Saar.

Mining Machinery.
Fraser & Chalmers, Ltd., 3, London Wall Buildings, London, E.C.

Office Appliances.
Halden & Co., J., 8, Albert Square, Manchester.
Hall & Co., B. J., 39, Victoria Street, London, S.W.
Inglesant, T., & Sons, Ltd., Atlas House, Leicester.
Lyle Co., Ltd., Harrison Street, Gray's Inn Road, London, W.C.
Rookwell-Wabash Co., Ltd., 69, Milton Street, London, E.C.
Shannon, Ltd., Ropemaker Street, London, E.C.
Trading and Manufacturing Co., Ltd., Temple Bar House, Fleet Street, London, E.C.

Oils, &c.
Blumann and Stern, Ltd., Plough Bridge, Deptford, London, S.E.
Valor Co., Ltd., Rocky Lane, Aston Cross, Birmingham.
Wells, M., & Co., Hardman Street Oil Works, Manchester.

Packing.
Beldam Packing & Rubber Co., 93-94, Gracechurch Street, London, E.C.
Frictionless Engine Packing Co., Ltd., Hendham Vale Works, Harpurhey, Manchester.
Lancaster & Tonge, Ltd., Pendleton, Manchester.
Redfern & Co., S., Swan Lane, New Brown Street, Manchester.
Quaker City Rubber Co., Coronation House, Lloyd's Avenue, E.C.
United States Metallic Packing Co., Ltd., Bradford.
J. Bennett von der Heyde, 6, Brown Street, Manchester.

Paper.
Lepard & Smiths, Ltd., 29, King Street, Covent Garden, London, W.C.

Patent Agents.
Page & Rowlingson, 28 New Bridge Street, London, E.C.

Pumping Machinery

FOR WATERWORKS AND MINES.

Official

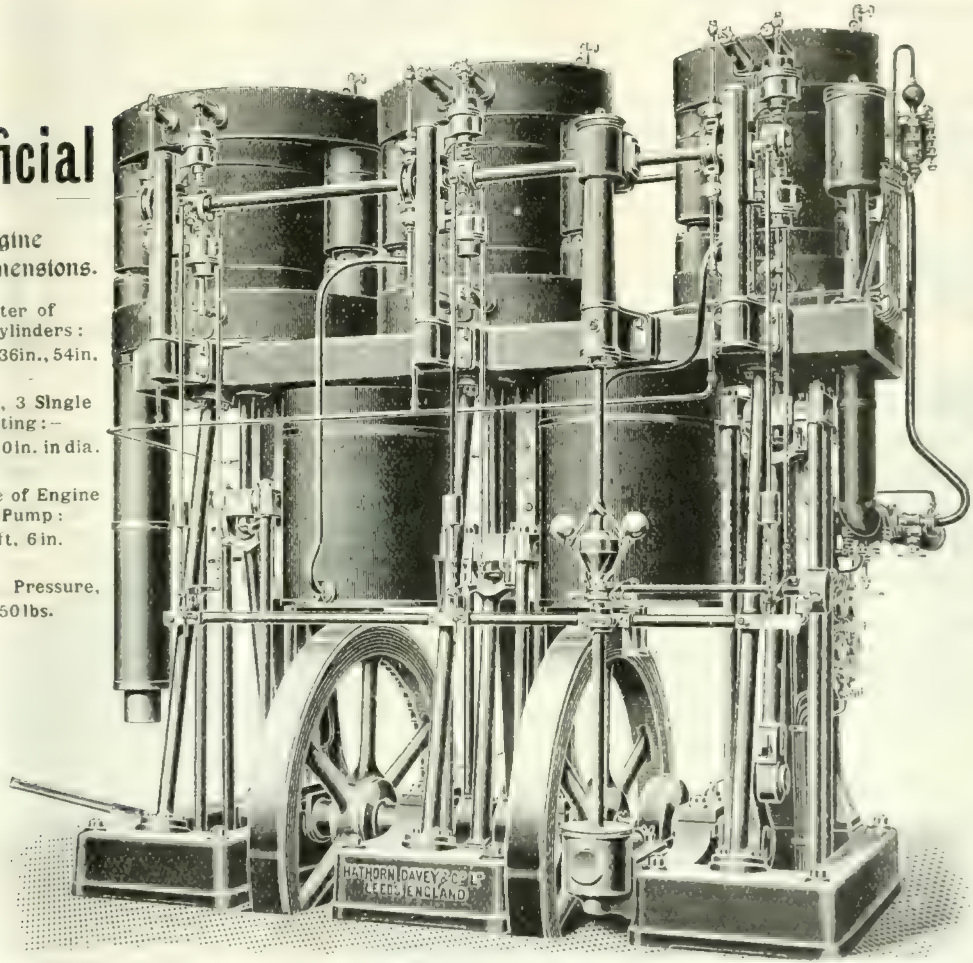
Engine Dimensions.

Diameter of Cylinders:
20in., 36in., 54in.

Rams, 3 Single Acting:–
Each 30in. in dia.

Stroke of Engine and Pump:
3 ft. 6 in.

Steam Pressure,
150 lbs.



Trial.

Engine Results.

Pump Horse Power:
274·55.

Saturated Steam per Indicated Horse Power per hour:
12·4 lbs.

Mechanical Efficiency:
92·8 per cent.

Contract Duty to raise 6,240 Gallons of sewage per minute 125 feet high.

Triple Expansion Sewage Pumping Engine, Melbourne and Metropolitan Board of Works.

HATHORN, DAVEY & Co., LIMITED.

LEEDS, England.

Codes Used
A.B.C. 4th Edition.
Universal Mining Code

Telegrams
HATHORN, LEEDS.

Buyers' Directory—(*Continued*).

Photo Copying Frames.

J. Halden & Co., 8, Albert Square, Manchester.
B. J. Hall & Co., 39, Victoria Street, London, S.W.

Photographers.

Booker & Sullivan, 67 and 69, Chancery Lane, W.C.
Elliott & Fry, 55, Baker Street, London, W.

Photographic Apparatus.

Marion & Co., Ltd., 22 and 23, Soho Square, London, W.

Pinch Bars.

Samson & Co., Garforth, near Leeds.

Pipe Wrenches (Chain).

Williams, J. H., & Co., Brooklyn, New York, U.S.A.

Pistons.

Lancaster & Tonge, Ltd., Pendleton, Manchester.

Planished Sheets.

Zeitz & Co., 21, Lime Street, London, E.C.

Porcelain.

Gustav Richter, Charlottenburg, near Berlin, Germany.

Presses (Hydraulic).

Greenwood & Batley, Albion Works, Leeds
Niles-Bement-Pond Co., 23-25, Victoria Street, London, S.W.

Publishers.

Charles Griffin & Co., Ltd., Exeter Street, Strand, London, W.C.
Spon, E. and F. N., 125, Strand, W.C.
New Zealand Mines Record, Wellington, New Zealand.

Pumps and Pumping Machinery.

Drum Engineering Co., 27, Charles Street, Bradford.
Enke, Carl, Schkeuditz-Leipzig, Germany.
Fraser & Chalmers, Ltd., 3, London Wall Buildings, London, E.C.
J. P. Hall & Sons, Ltd., Peterborough
Hathorn, Davey & Co., Ltd., Leeds, England
Positive Rotary Pumps, Ltd., 23, Northumberland Avenue, London, W.C.
Tangyes, Ltd., Cornwall Works, Birmingham.

Radial Drilling Machines.

Asquith, William, Ltd., Well Road Works, Halifax.
Greenwood & Batley, Albion Works, Leeds.
Niles-Bement-Pond Co., 23-25, Victoria Street, London, S.W.
Northern Engineering Co. (1900), Ltd., King Cross, near Halifax.
Swift, George, Claremont Ironworks, Halifax.

Rails.

Wm. Firth, Ltd., Leeds

Railway Wagons.

Nye, A. W., 110, Cannon Street, London, E.C.
W. R. Renshaw & Co., Ltd., Phœnix Works, Stoke-on-Trent.

Riveted Work.

F. A. Keep, Juxon & Co., Forward Works, Barn Street, Birmingham.

Roller Bearings.

Hyatt Roller Bearing Co., 47, Victoria Street, London, S.W.

Roofs.

D. Anderson & Son, Ltd., Lagan Felt Works, Belfast.
Head, Wrightson & Co., Ltd., Thornaby-on-Tees.

Ropeways (Aerial).

Bullivant & Co., Ltd., 72, Mark Lane, London, E.C.

Scientific Instruments.

Cambridge Scientific Instrument Co., Ltd. Cambridge.

Spanners.

Williams, J. H., & Co., Brooklyn, New York, U.S.A.

Stampings.

Thomas Smith & Sons of Saltley, Ltd., Birmingham.
Williams, J. H., & Co., Brooklyn, New York, U.S.A.

Stamps (Rubber).

Rubber Stamp Co., 1 & 2, Holborn Buildings, Broad Street Corner, Birmingham.

Stamps (Metal).

Edward Pryor & Son, 68, West Street, Sheffield.

Steam Traps.

British Steam Specialties, Ltd., Fleet Street, Leicester.
Lancaster & Tonge, Ltd., Pendleton, Manchester.

Steam Wagons.

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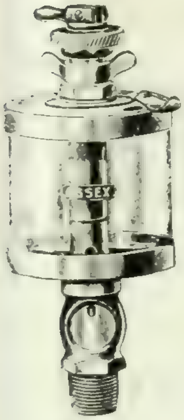

FIG. 33

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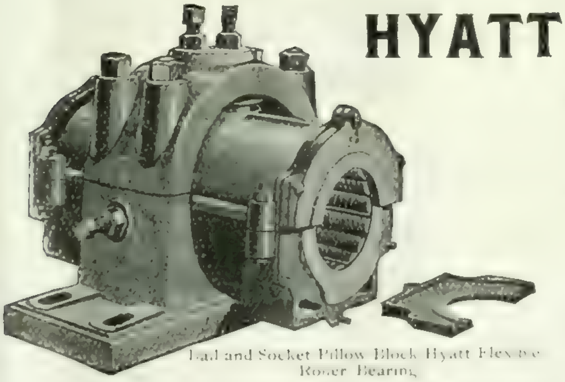

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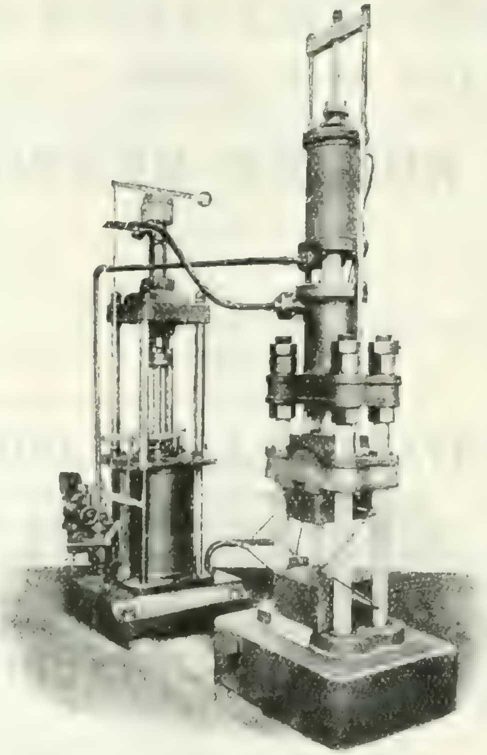

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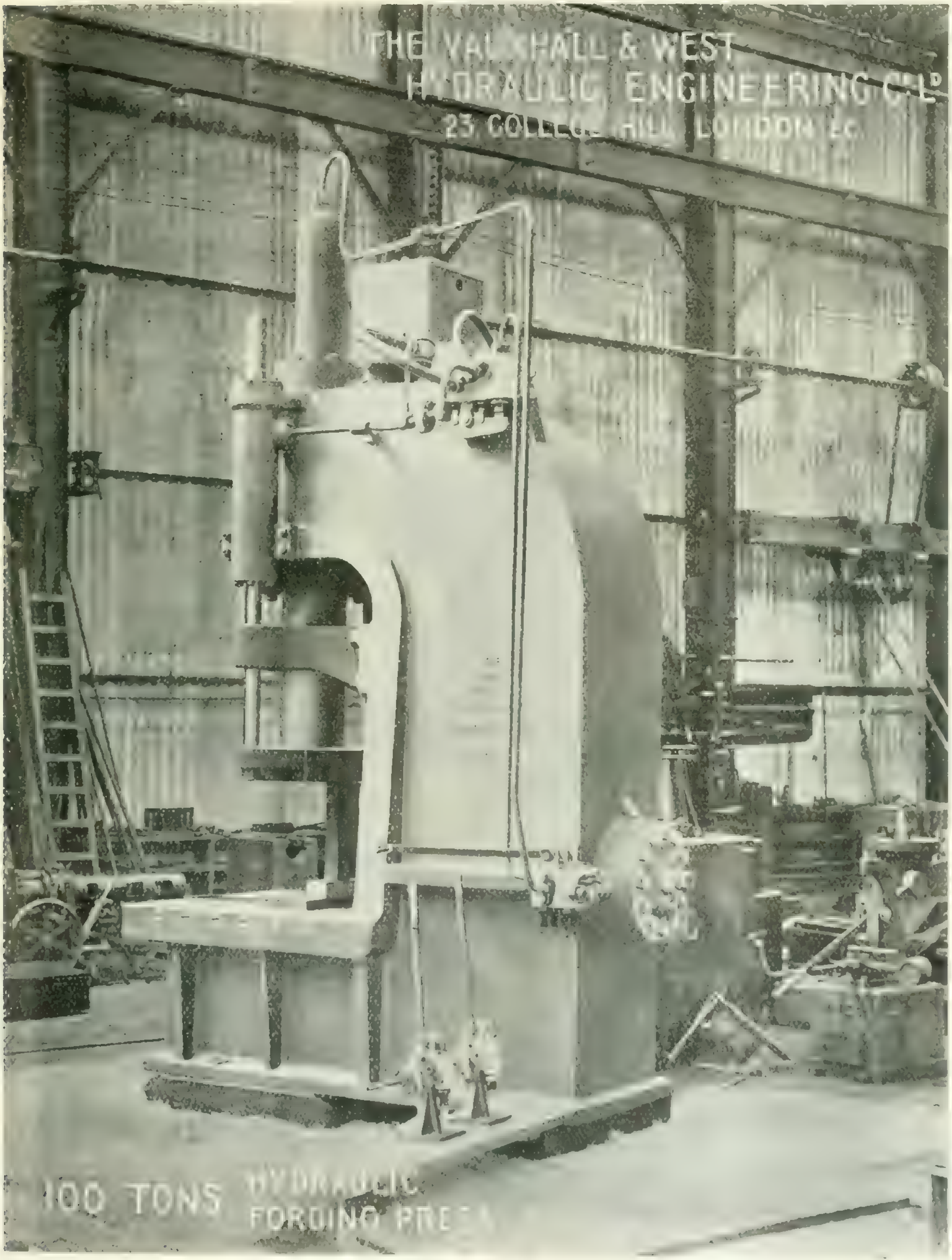

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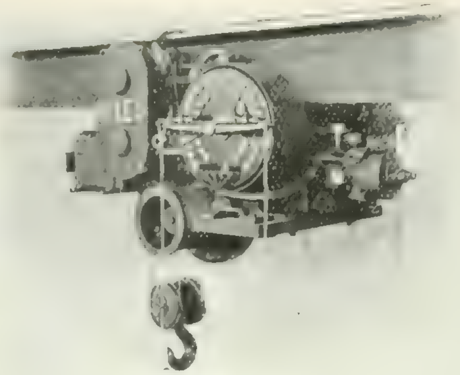

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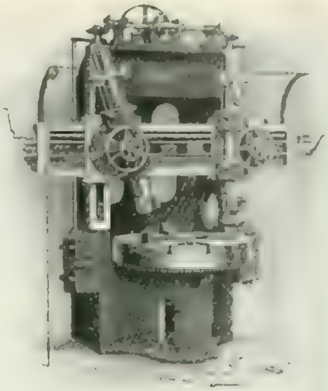
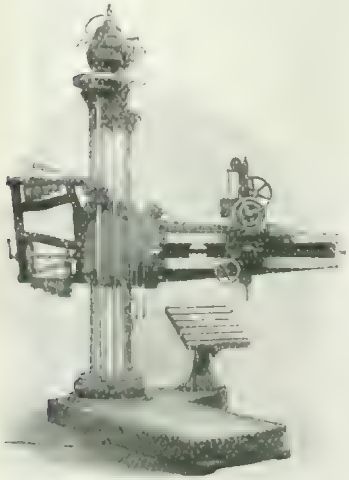
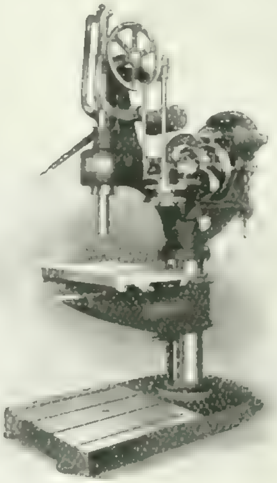


37 in. Boring Mill.



5½ft. Universal Radial Drill.



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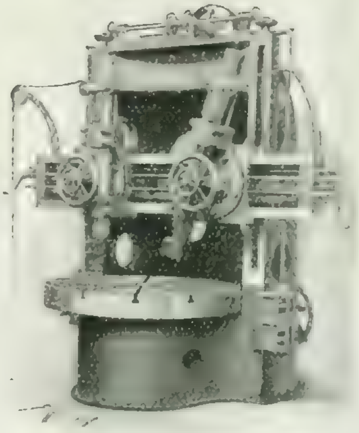
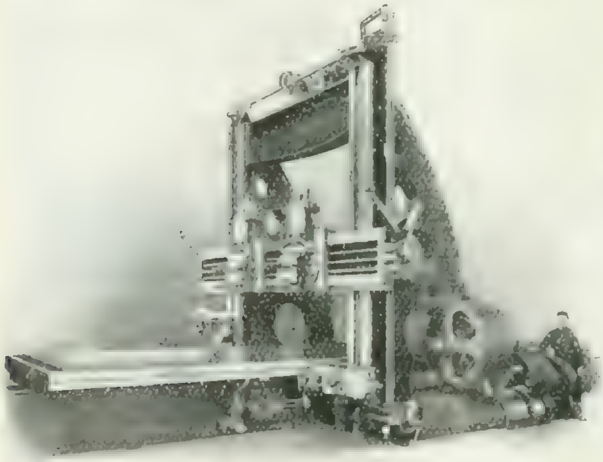


51in. Boring Mill.



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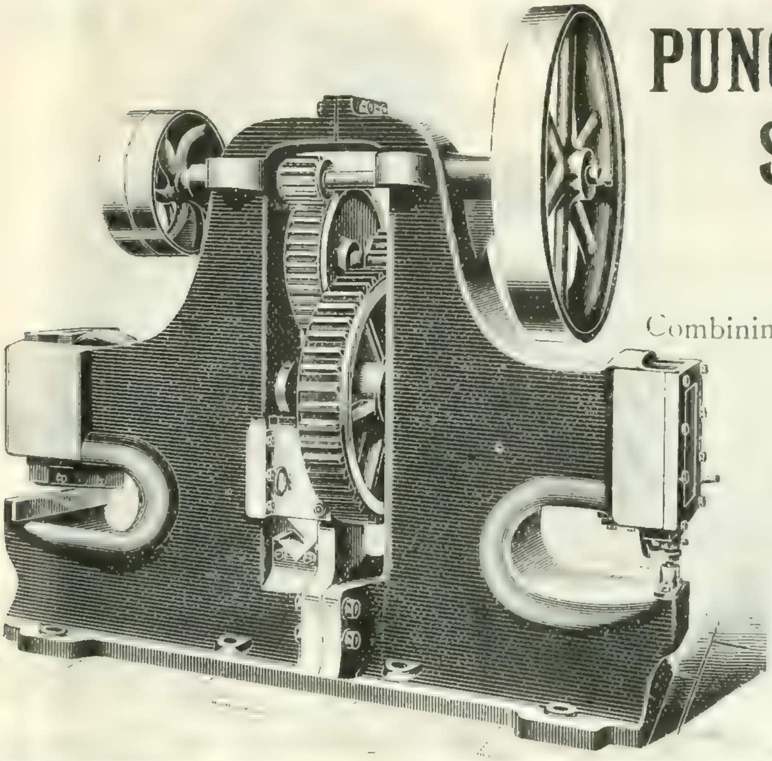

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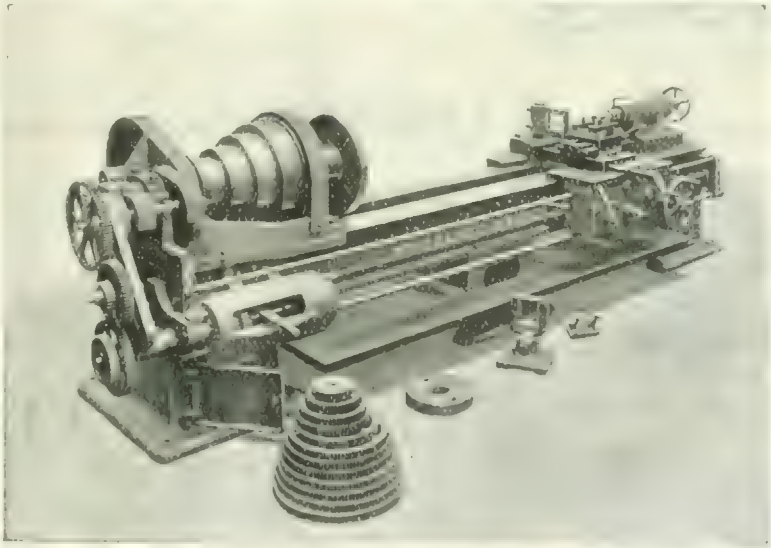

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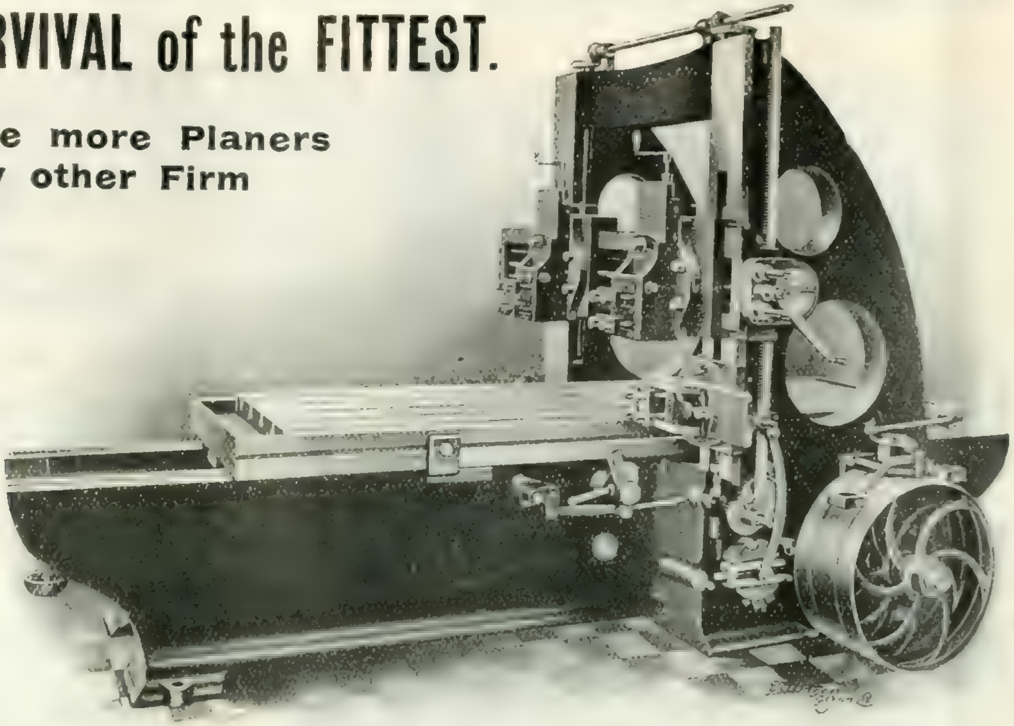

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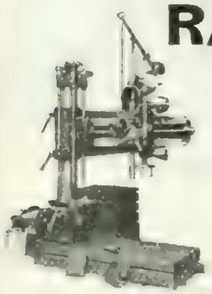

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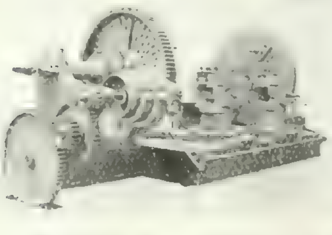

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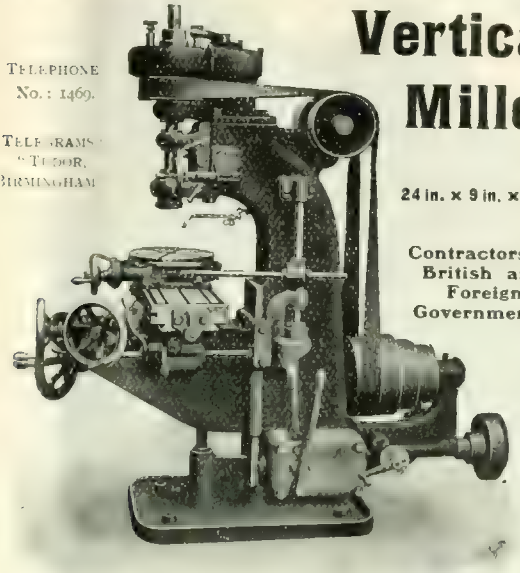

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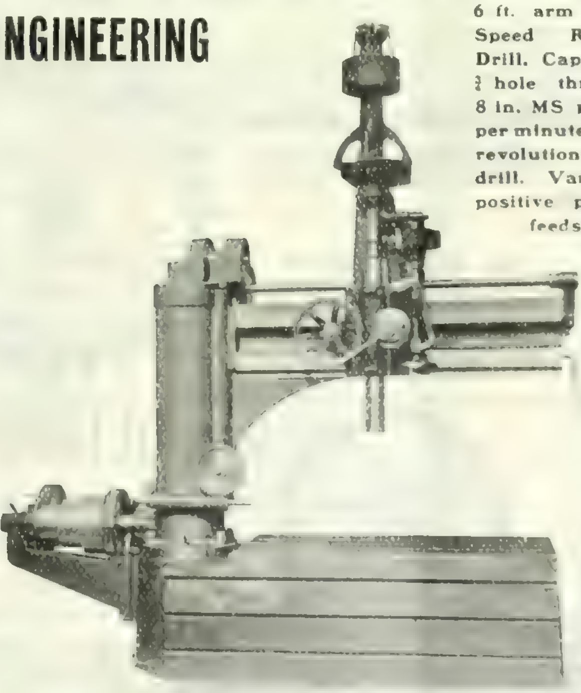

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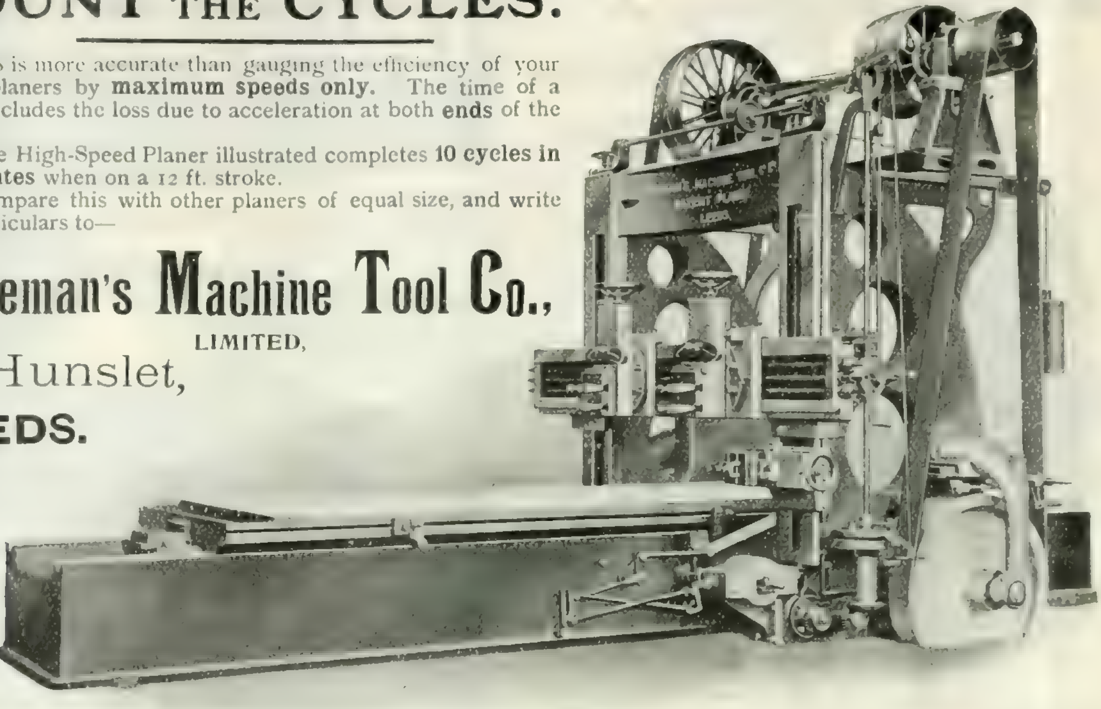

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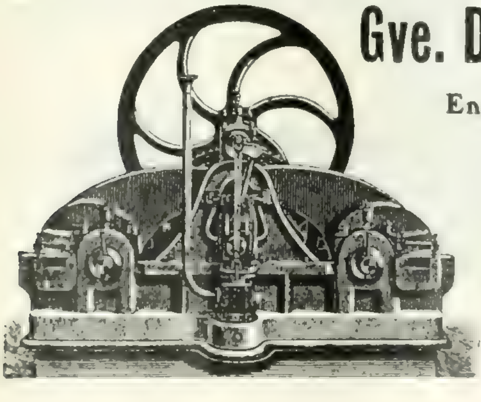

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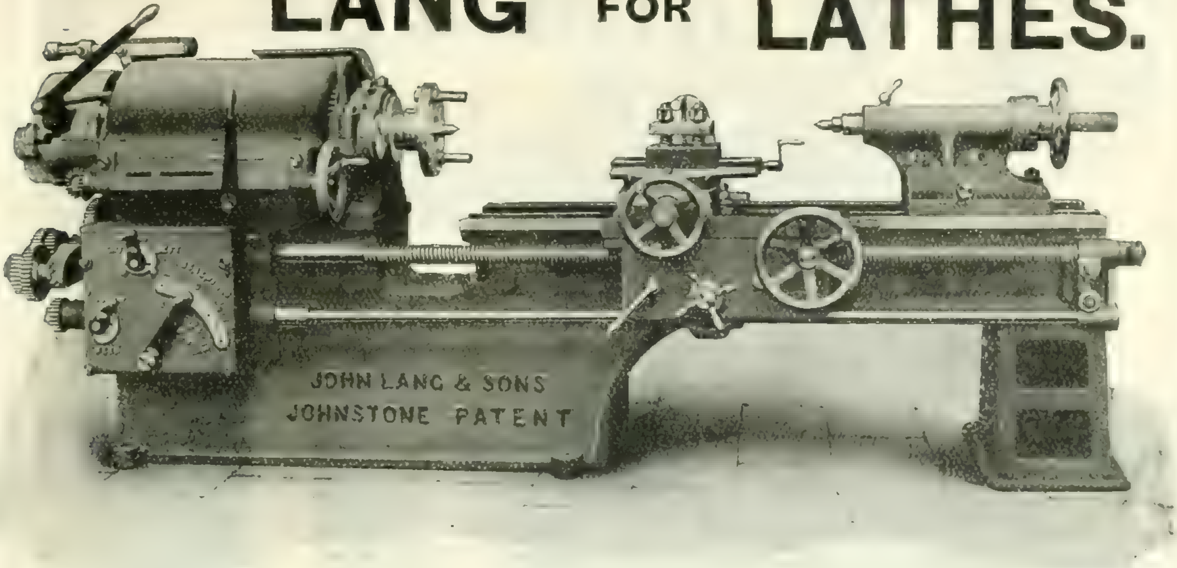

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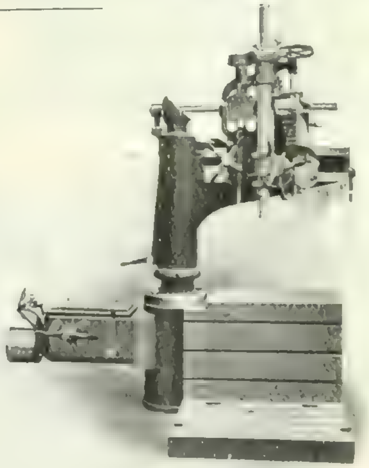

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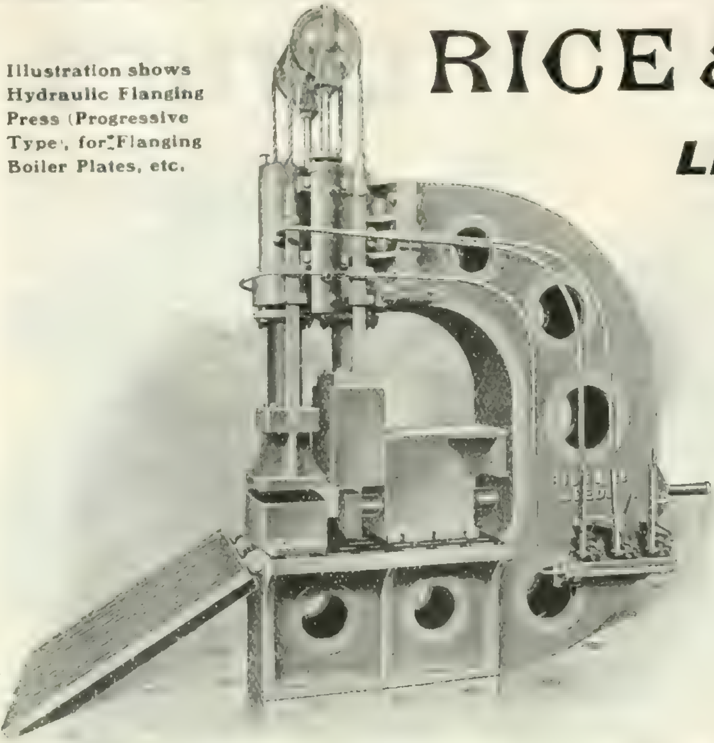

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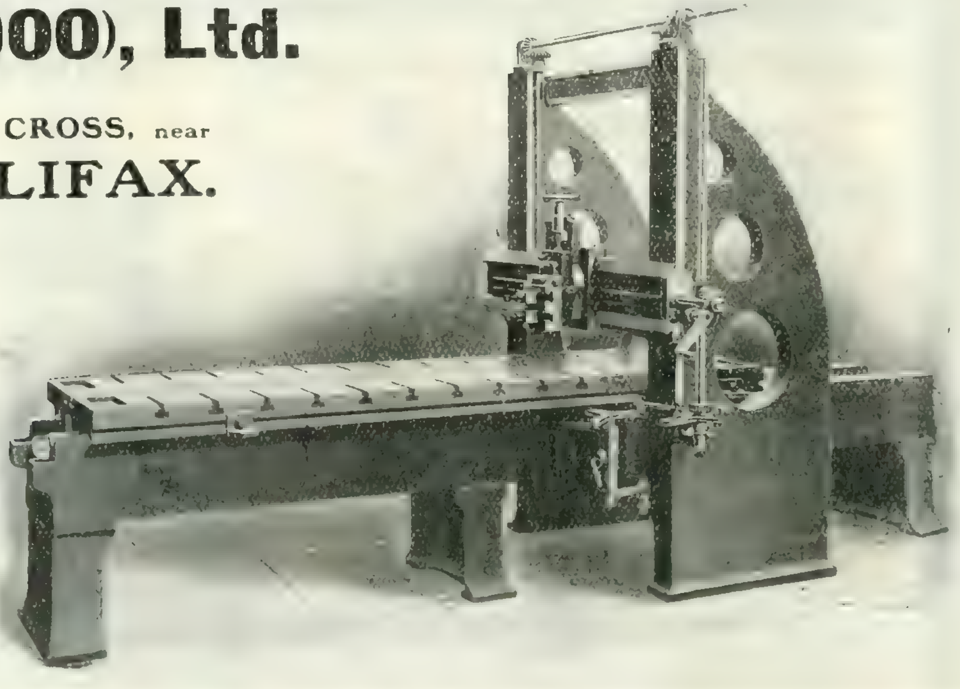

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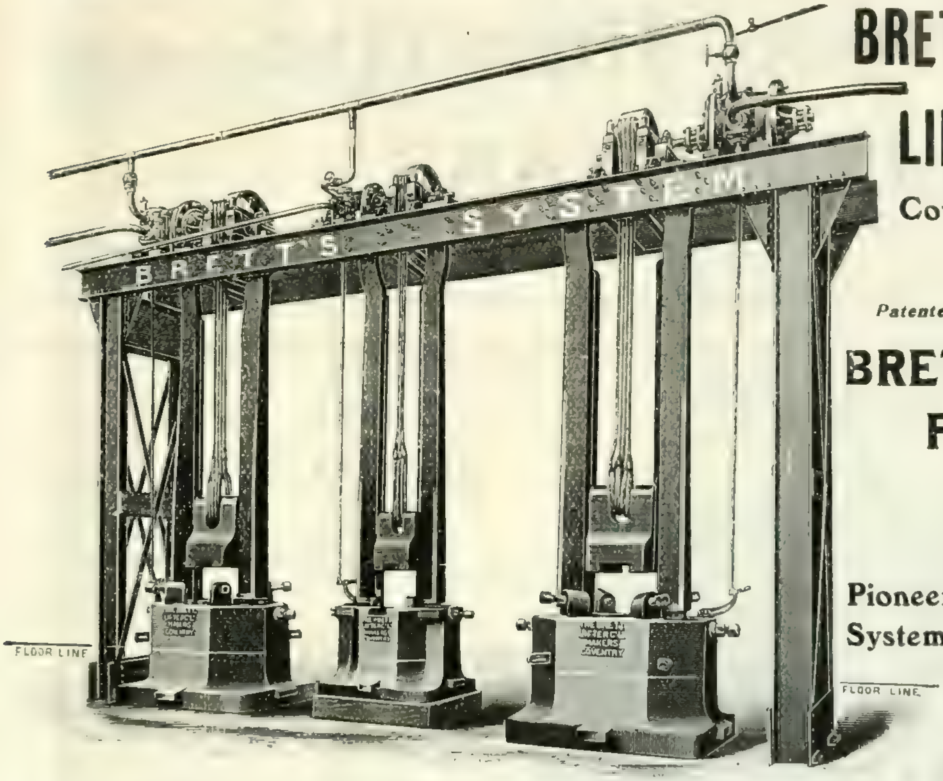

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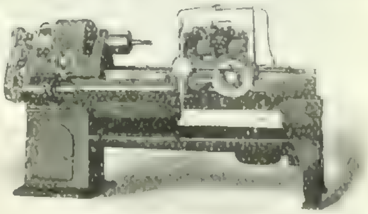

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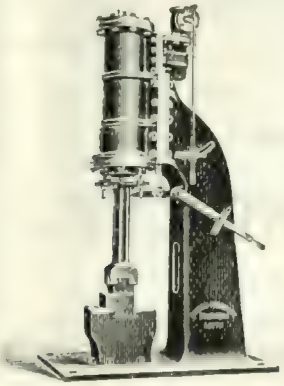

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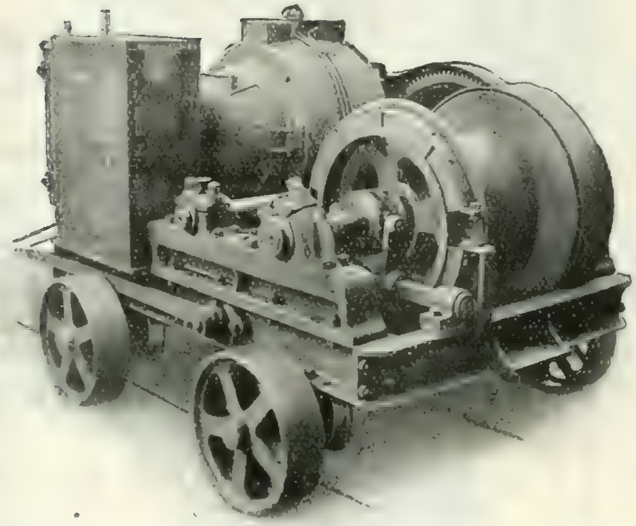

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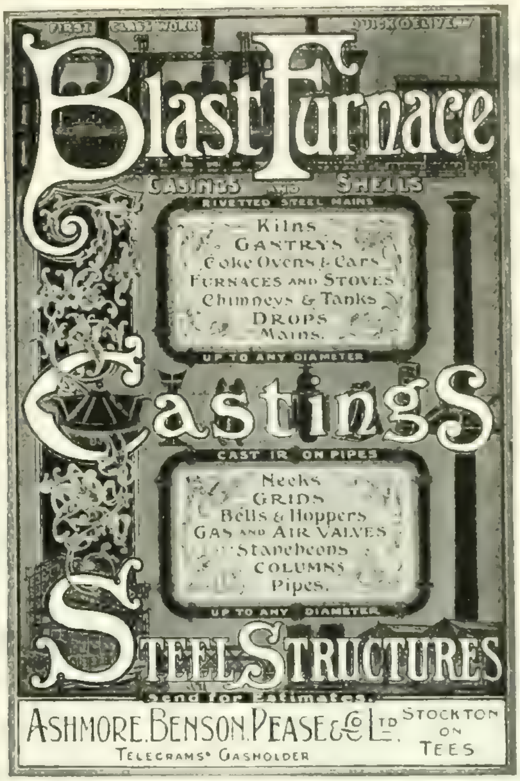

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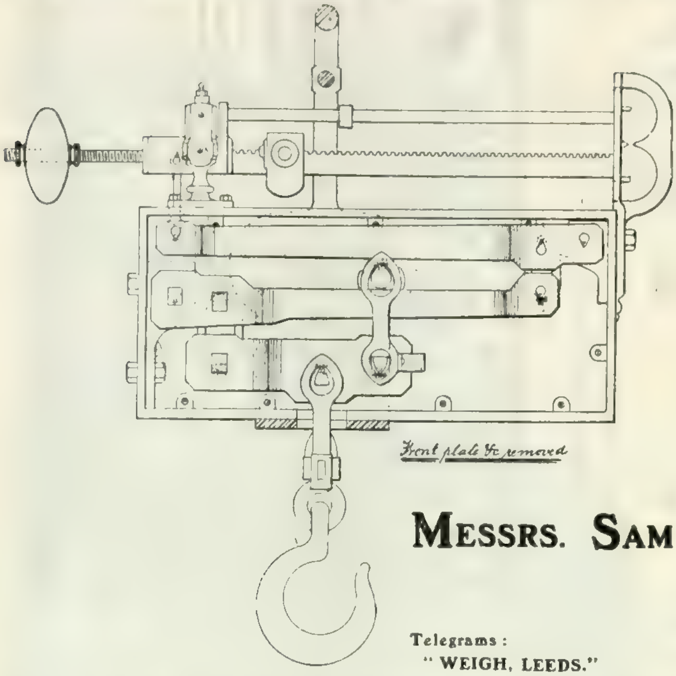

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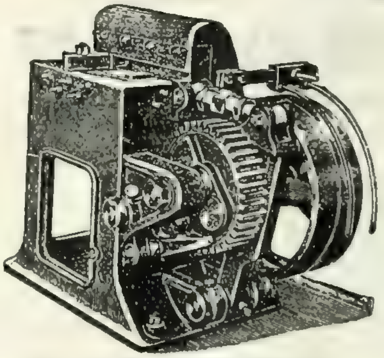

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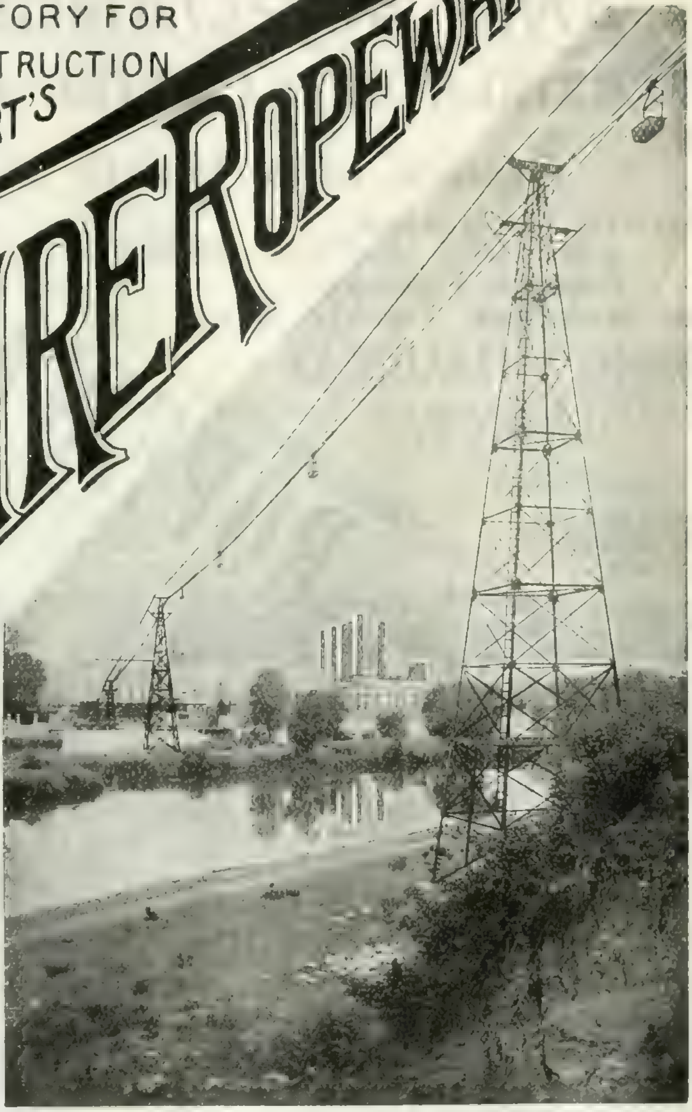

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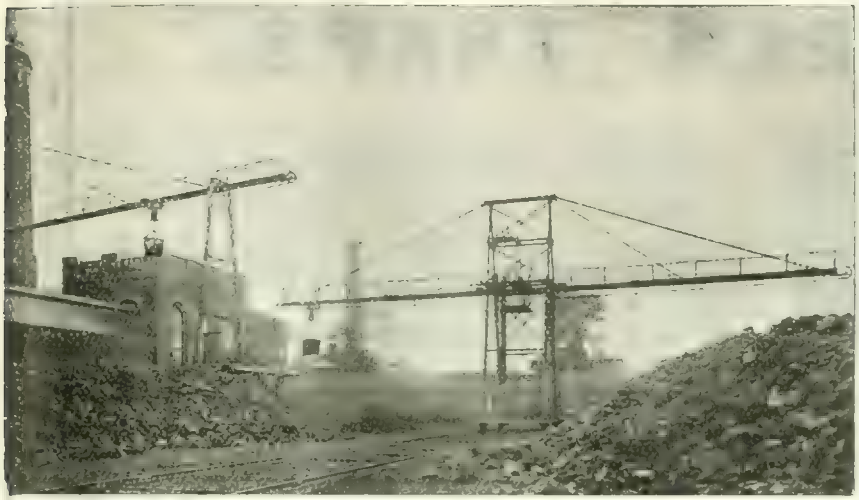

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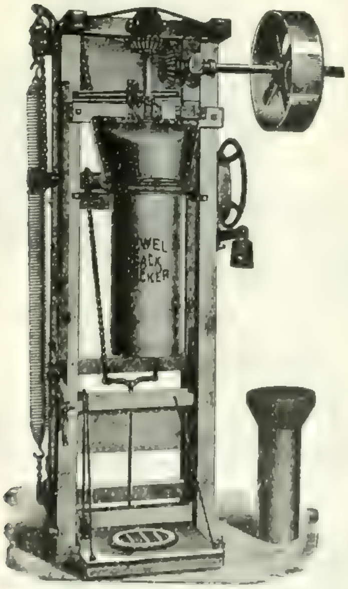

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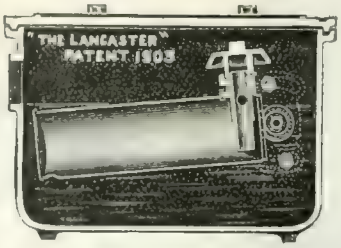

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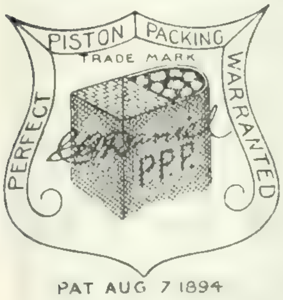

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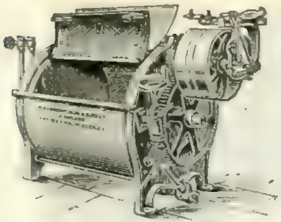

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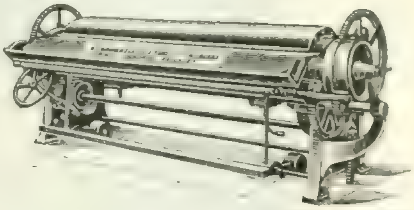

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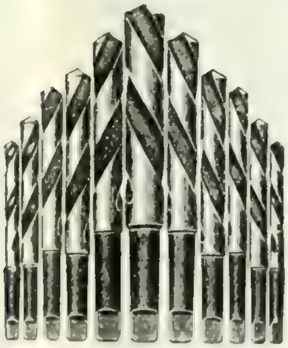

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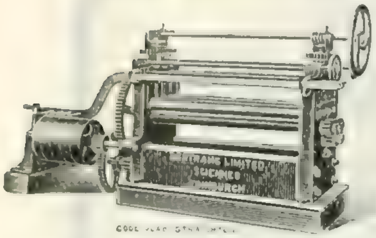

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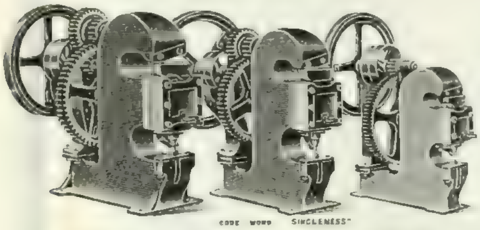

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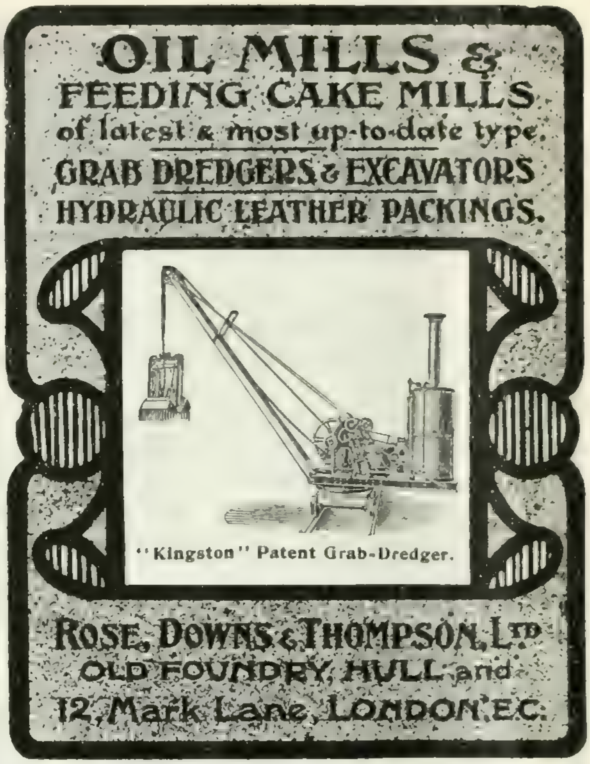

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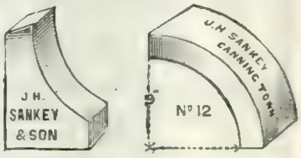

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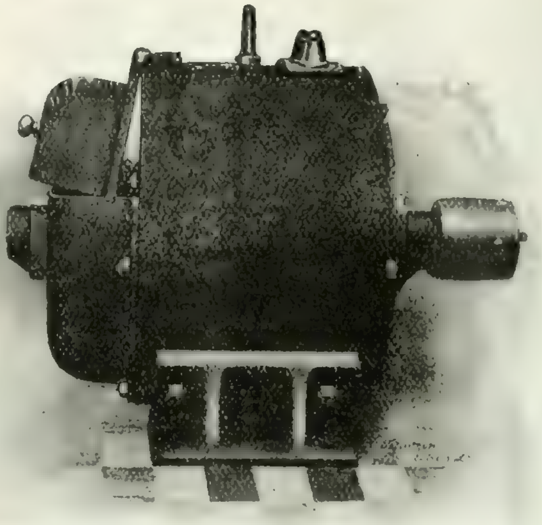

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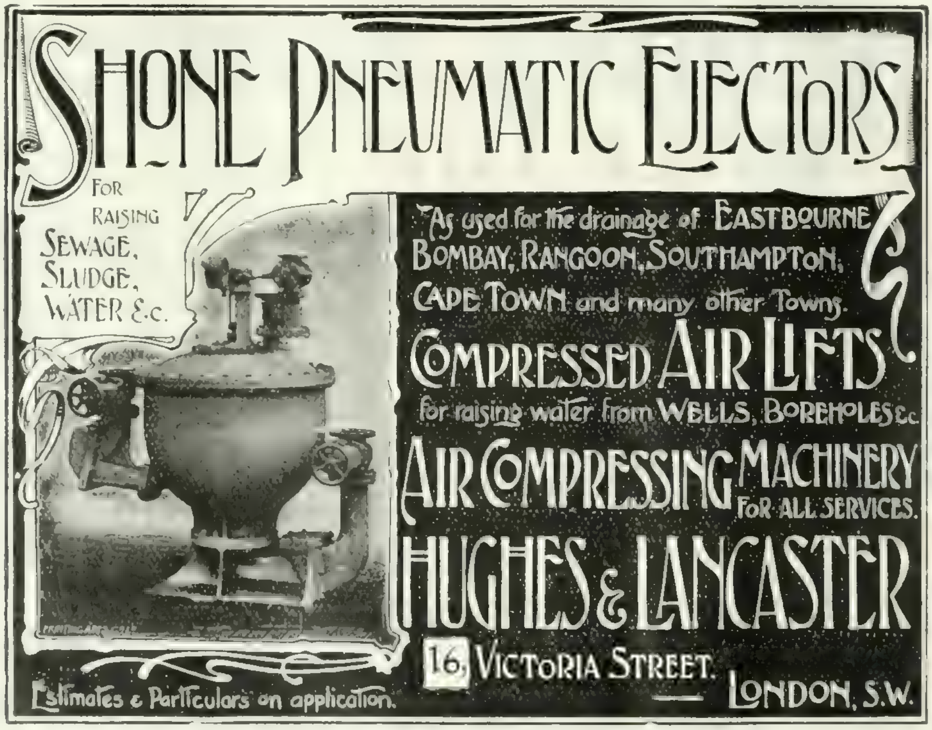

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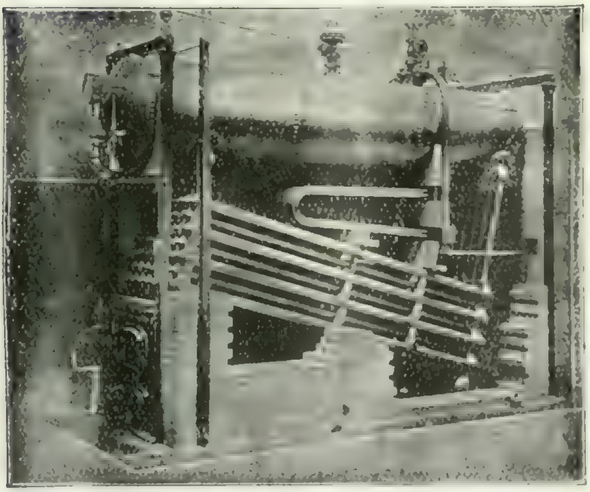

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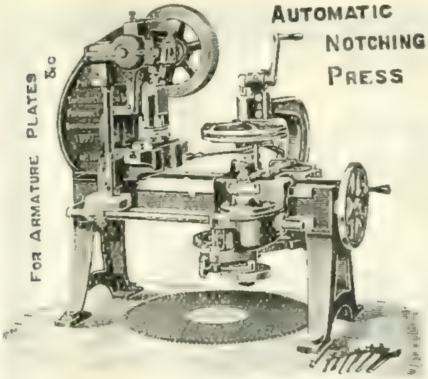

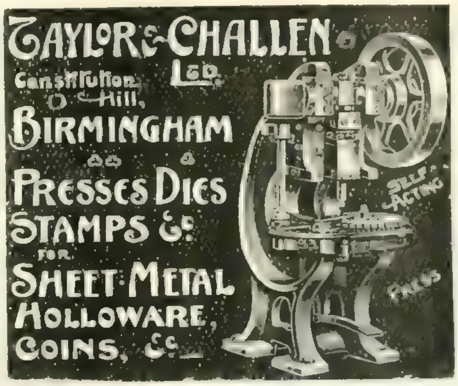

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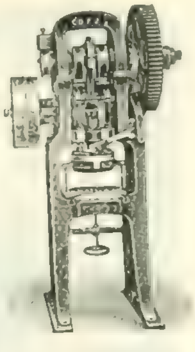

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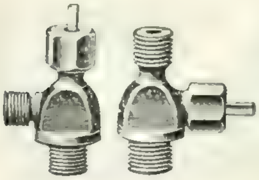

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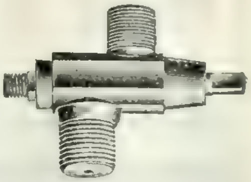

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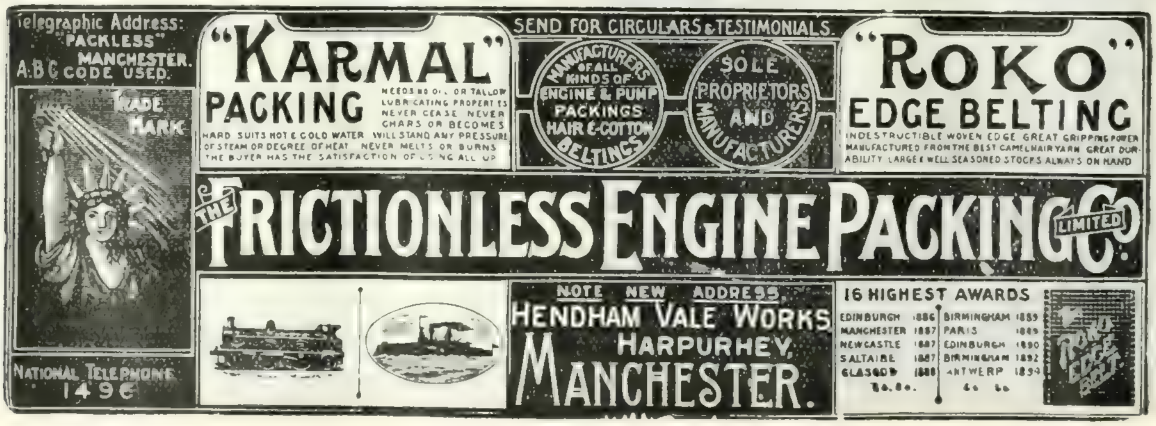

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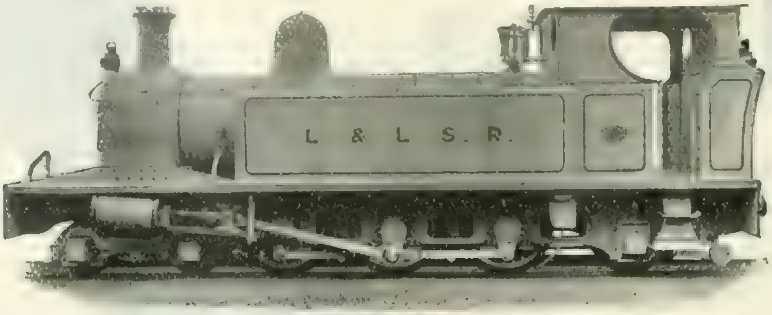

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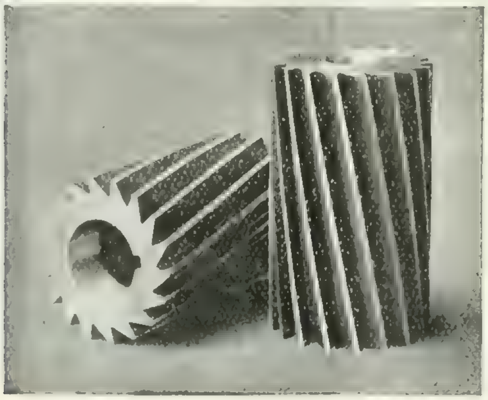

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PAGE'S WEEKLY

An Illustrated Technical Weekly, dealing with the Engineering, Electrical, Mining, Iron and Steel, and Shipbuilding Industries.

Vol. VII. LONDON, FRIDAY, SEPTEMBER 29, 1905. No. 155.

The Offices of "Page's Weekly,"
Wednesday Evening.

THE two chief events of the week are the opening of the Electrical Exhibition at Olympia, and the holding of the autumnal meeting of the Iron and Steel Institute at Sheffield. The latter body is undoubtedly unique in its place of meeting. Sheffield is the cradle of the world's steel industry, and, as readers are aware, the Institute is an intellectual centre for those engaged in it. It will be remembered that two general meetings of the Iron and Steel Institute are held each year, one in London in May, and the other in the autumn in such locality at home or abroad as the council may decide.

Since the establishment in 1869, the autumn meetings of the Institute have been held in the following localities:—

1869—Middlesbrough-on-Tees.
1870—Merthyr Tydfil.
1871—Dudley.
1872—Glasgow.
1873—Liége.
1874—Barrow-in-Furness.
1875—Manchester.
1876—Leeds.
1877—Newcastle-on-Tyne.
1878—Paris.
1879—Liverpool.
1880—Dusseldorf.
1881—London.
1882—Vienna.
1883—Middlesbrough-on-Tees.
1884—Chester.
1885—Glasgow.
1886—London.
1887—Manchester.
1888—Edinburgh.
1889—Paris.
1890—New York.
1891—London.
1892—Liverpool.
1893—Darlington.
1894—Brussels.
1895—Birmingham.
1896—Bilbao.
1897—Cardiff.
1898—Stockholm.
1899—Manchester.
1900—Paris.
1901—Glasgow.
1902—Düsseldorf.
1903—Barrow-in-Furness.
1904—New York.

No more appropriate meeting place in Sheffield could have been devised than the fine hall placed at the disposal of the Institute by the University of Sheffield, which now claims to possess the finest metallurgical laboratory in the world devoted to the investigation of the problems surrounding the manufacture and the working of steel. Peculiar interest was lent to the proceedings by the presence

ROBERT ABBOTT HADFIELD,
President of The Iron and Steel Institute.

THE WORKS OF THE SHEEPBRIDGE COAL AND IRON COMPANY, LTD., NEAR CHESTERFIELD.

Visited by the Iron and Steel Institute on Tuesday of Dr. Sorby, the pioneer of the science of metallography, Mr. J. D. Ellis, the veteran metallurgist, and Professor Arnold, joint author of the paper on the thermal transformation of carbon steels which was referred to by the president as one of the most important read for many years, as in it the author had given definite shape and concreteness to a whole cloud of nebulous theory.

As was inevitable the paper provoked a discussion, which, with written contributions, is likely to be a notable addition to the Transactions. Mr. J. E. Stead praised the paper as a clear expression of facts, and what were believed to be facts, as well as a confession of faith on the very complex changes and conditions which iron and carbon were capable of assuming; it was also a criticism of the theoretical conclusions of those who did not see eye to eye with the authors. It was not his intention to controvert the author's hypotheses with regard to the nature of hardened steel, as it seemed to him undesirable to resurrect a controversy upon a subject about which there was still insufficient data to form a dogmatic opinion.

He believed, however, that allotrophy most probably played an important part. He thanked the authors for their paper, as it showed exactly the position they now held, and would suggest that although there was still considerable divergence in what might be described academical opinion, all earnest metallurgists and workers endowed with the true scientific love for their work were ready and willing to renounce their old opinions should convincing proof be revealed of their untenability.

Professor Lange thought it would be better to simplify the combinations of iron and carbon by referring to them as structures of a particular type. It was a question whether martensite was really something absolutely definite. It would be preferable to speak of a martensitic structure rather than to attach a particular and definite meaning to martensite itself. Professor Turner and Mr. Harbord also took part in the discussion. Even Dr. Sorby was impelled to speak on this paper. He referred to the fact that his early researches attracted little or no attention, although so much had since arisen out of them. The longer he lived the more impressed was he with the remarkable properties and qualities of iron, and he would like to begin the work of investigation all over again.

Mr. Gledhill was anxious about the "ghost" problem. No steel maker could produce ingots absolutely free from ghost lines, and he commented on the curious fact that two ingots might be cast under precisely the same conditions, and one ingot would contain ghost lines and the other not. He wanted this subject investigated, and a real solution of the problem reached. Mr. Bauerman fell foul of the nomenclature employed by the authors of the paper which he did not think served any useful purpose. He also rather cast doubts upon the utility of metallography. The utterance of what sounded like heresies in the hall of the University where these studies are reckoned of high importance, drew a spirited rejoinder from Mr. McWilliam, the joint author of the paper.

Professor Arnold in his reply emphasised the points raised by Mr. McWilliam. It was not alpha, beta, and gamma varieties of iron which were referred to in the paper, but ranges of temperature so named and carefully specified. It was not certain that there were allotropic changes of iron, and he failed to see any permanent value in Mr. Stead suggesting that such was the case. He deprecated the practice of putting new meanings to old names like sorbite and troostite, a course which he considered likely to create confusion.

In the discussion which followed the reading of the paper on the use of vanadium steel for motor-car construction, Mr. Weiner paid a warm tribute to the author's researches on the subject. He was personally convinced that practical alloys would only have 1 per cent., if not less, of vanadium. Mr. Mark Robinson pointed out that vanadium steel was already extensively used in this country for motor-car manufacture, a statement which was confirmed by Mr. Kent Smith.

The Electrical Exhibition at Olympia opened its doors to the public on Monday last. There was the usual feverish eleventh hour rush to get the place swept and garnished for the opening ceremony, and even while the Lord Mayor and Sheriffs with their entourage were inspecting the exhibits preparatory to declaring the place open, workmen were engaged in fixing red cloth on the platform reserved for the ceremony, and at the very last minute a statue of Victory which adorned the background was being decorated with dangling wreaths. This kind of thing appears inevitable, and the complacence of the Lord Mayor in making so prolonged a tour of the stands saved the situation, although it kept a few hundred hungry people from their lunch.

All this notwithstanding, a first visit to Olympia, leads to the conclusion that the anticipations of the committee will be realised, and that the Exhibition will be the most important of its kind held for many years. The main purpose of the Exhibition is, of course, to demonstrate the practical application of electricity to the needs of modern life. No special predominance is accorded to any one class of exhibit, each branch of the industry, lighting, power and heating, being represented, and a point to which attention may be fairly directed is the fact that the Exhibition is to all intents and purposes a British Exhibition.

And in this connection Col. Crompton's defence of the position held by Great Britain in the electrical industry is worth notice. He did not intend to apologise for England, for he believed that she stood right at the top of the industry, and, indeed, always had been there. The reason why ill-educated people imagined that greater things were being done in America or on the Continent was because of the relatively great importance of the electrical industry in those countries. The industry loomed large in Germany, because from its growth had arisen the commercial importance of that country, and the same was true in lesser degree of America. He had no word of criticism against the splendid progress made by our trade rivals, but he was concerned to defend his own industry from ill-informed attacks. The best answer to the critics was the present Exhibition. So far, Col. Crompton was on fairly safe ground, but his statement that he had never seen an Exhibition so far advanced on the opening day must be put down to the license allowed to speakers on these occasions.

The Mayor of Hammersmith voiced the views of municipal electrical undertakings. He pointed out that thirteen London municipalities had invested £4,172,000 in the electrical business, while provincial authorities had expended in electrical undertakings a sum of £24,689,000. The object of the municipalities in entering the field of enterprise was to supply current to consumers at the lowest possible price, and in Hammersmith, where they had originally a rate of 6d. per unit for the first hour, and 4d. per hour afterwards, they had got down to a flat rate of 3d. per unit. Mr. Patchell restored the Exhibition to its proper perspective. It is, as he claimed, an important undertaking, but it does not challenge comparison with some of the international exhibitions which have preceded it. The exhibits are dealt with elsewhere in this issue.

PAGE'S WEEKLY

An Illustrated Technical Weekly, dealing with the Engineering, Electrical, Mining, Iron and Steel, and Shipbuilding Industries.

DAVIDGE PAGE, Editor.

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Alterations, &c., intended for insertion in the current week's issue must be delivered **not later than 4 p.m. on Monday.** If proofs are required the copy and blocks should reach us several days earlier.

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NEWS ITEMS.

The Institute of Chemistry of Great Britain and Ireland announces a scheme for examinations in technical chemistry.

At the next meeting of the Society of Engineers, to be held on the 2nd prox., at the Royal United Service Institution, Whitehall, a paper will be read entitled "Machine Drills for Hard Rock," by Mr. Arthur H. Smith.

Negotiations have for some time past been proceeding between the Government of the Straits Settlements and the Tanjong Pagar Company, for the acquisition of the property of that company at Singapore by the Colonial Government, which is anxious to acquire it in the future interests of the port.

In view of the successful experiments on the *Lucania*, and [illegible] is extending the use of submarine signalling apparatus. The Mersey Docks and Harbour Board have had the north-west lightship in Liverpool Bay fitted with a submarine bell, which on Saturday was heard distinctly on the navigating bridge of the *Lucania* at a distance of nine and a half knots.

The strong position of the English shipbuilding is demonstrated in returns just to hand by the fact that in 1904 the tonnage of vessels built in the United Kingdom was 884,259; in the United States, 387,28[illegible]; Germany, 162,058; and France, 75,915. Foreigners employed on British ships numbered 39,832. These figures do not include Lascars and Asiatics, who numbered 42,682. The number of Britons was 176,075.

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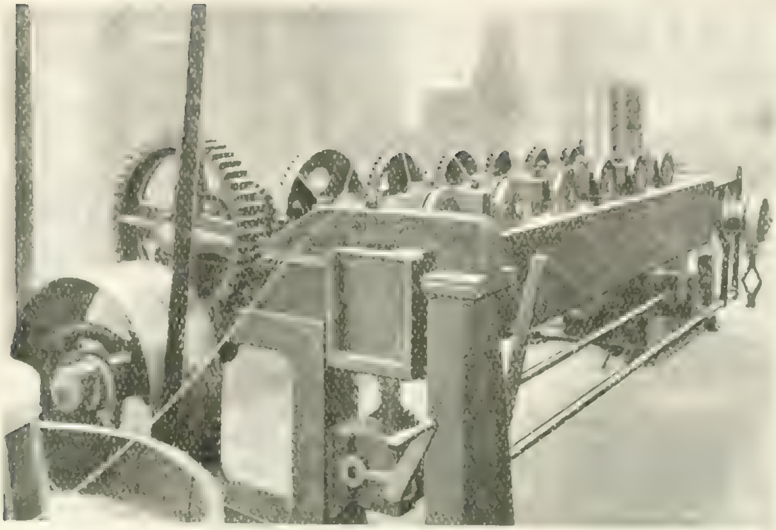


PATENT CONTINUOUS WIRE-DRAWING MACHINE.

The Junior Institution of Engineers.

A visit of this Institution recently took place to the Staines Reservoir Construction Works, which was arranged with the object of affording the members the opportunity of seeing the works in an almost completed state, a visit having been paid some time ago, when all the operations of construction were seen in process. The members were shown round by Mr Joseph Francis, engineer of the works, Mr. C. W. Pettit, representing the contractors, Messrs. John Aird and Sons and Mr. Durham, of the Metropolitan Water Board.

A Patent Continuous Wire-Drawing Machine.

The accompanying illustration shows a notable improvement in wire-drawing machinery, by Mr. Ed. Brand, of Manchester, the wire being drawn continuously several sizes down in one operation. It is not submitted to an irregular working, but follows a straight line, each die being placed in an horizontal line, and each small block pulling the wire through the die revolving in a cooling lubricant.

The type of machine illustrated is made in four sizes for wire from No. 10 to 40 B.W.G. The No. 1 machine which is here shown, is able to draw hard steel wire with seven dies, from No. 14 to 20 B.W.G. in one operation, turning out about 300 lb. of wire per day. The operator is able to attend easily to several machines. The machine is finding an extensive use by some of our largest wire manufacturers for drawing hard steel wire for rope, hawser, etc. We understand that other classes of metal have also been drawn with these machines with great success. The maker recently supplied several to a firm in France upon the guarantee of their being found suitable for drawing German silver (nickel) wire, this wire being known as extremely difficult to draw more than two to three sizes without annealing. With the new machine this wire has been drawn with seven dies in one operation, the finished wire proving to have kept all its quality besides being better drawn than with the ordinary wire blocks.

M. Emile Guarini has been appointed by the Peru Government, Professor at the School of Engineers and at the new school of "Artes y Oficies."

From the Staines Reservoir intake the water will flow into a suction tank (one million gallons capacity), from which it will be pumped to a height of 24 ft. into two subsiding reservoirs (300 million gallons joint capacity). Thence it will flow through 42-in. pipes to the filter beds, twelve in number. Sand-washing apparatus is provided, and settling tanks and coke filters for treating the effluent sand-washing water before its delivery into the Thames. The filtered water will be pumped through a 42-in. main to Cricklewood (13½ miles), where it will be again pumped 3¾ miles to a service reservoir at Fortis Green, Finchley, at a level of 298 ft. above o.d. The engine house at Kempton Park contains two first-lift engines, three second-lift engines, and eight boilers. At the conclusion of the visit the members were entertained to tea by Messrs. John Aird and Sons, and the acknowledgments of the Institution for all the arrangements made were expressed by Mr. Adam Hunter, vice-chairman, and were responded, to by Mr. Francis and Mr. Pettit.

Sheepbridge Coal and Iron Company.

At the annual meeting of this company held at Sheffield on Monday last the Chairman reported that the position of the company was improving. During the past year the company had earned a dividend of 7½ per cent., which, all things considered, he thought was a satisfactory achievement. The company had also accumulated a reserve fund of £220,000. Sir Charles McLaren said that the company started the fresh financial year with excellent prospects.

AUTUMN MEETING OF THE IRON AND STEEL INSTITUTE.

THE Sheffield meeting opened on Tuesday morning in the presence of a distinguished company at the Firth Hall of the Sheffield University, which was used for the first time since it was recently opened by the king.

Among those present were the Lord Mayor of Sheffield (Sir Joseph Jonas), the Master-Cutler (Mr. G. Hall), Sir Charles Eliot, K.C.M.G. (Vice-Chancellor of Sheffield University), Colonel Hughes (Chairman of the Sheffield Reception Committee), Dr. H. C. Sorby, Mr. Holmshaw, Mr. R. A. Hadfield (President), and many leading members of the Institute, including Mr. E. P. Martin, Professor Arnold, Sir James Kitson, Sir Hugh Bell, Mr. E. Windsor Richards, Sir J. Alleyne, Messrs. H. Bauerman, W. H. Bleckly, David Colville, William Evans, J. M. Gledhill, Sir Alfred Hickman, Sir E. H. Carbutt, Messrs. Arthur Keen, A. Lamberton, Sir W. T. Lewis, Messrs. James Riley, G. J. Snelus, J. E. Stead, A. T. Tannett-Walker, Professor Thomas Turner, Colonel Vickers, Dr. Wedding (Berlin), Messrs. J. M. While, and William Whitwell.

The attendance of members and their friends numbered over a thousand, being the largest attendance at an autumn meeting in the history of the Institute.

At the initial proceedings, Colonel Hughes, chairman of the reception committee, presided, and formally welcomed the Institution to Sheffield. The Lord Mayor and the Master-Cutler associated themselves with the welcome tendered by Colonel Hughes, while Mr. Holmshaw voiced the sentiments of the Federated Trades Council of Sheffield.

THE RECOGNITION OF METALLURGY

Sir Charles Eliot, Vice-Chancellor of the Sheffield University, said that this was the first occasion on which the Firth Hall had been used since the University buildings were opened in July by His Majesty the King, and he could not conceive a more felicitous or appropriate coincidence than that which made the occasion of its inauguration to be that of their visit. There was very close connection not only between Sheffield and steel, but also between the University and that metal. He believed he was right in saying that the Sheffield University was the only University, at any rate in England, which recognised metallurgy as a science; and as in these days of competition educational establishments must to some extent specialise, he hoped that the science of metallurgy would confer distinction and renown upon the Sheffield University. That there was a great practical opening for the teaching of that science no one could doubt, a fact which was brought home to him by Professor Arnold only the previous day on his return from South Africa. The mining engineers in South Africa, many of whom drew salaries amounting to several thousands of pounds, were almost without exception Americans. He certainly thought that they required some institution which would enable us to provide in England the material to supply those posts. He was told that there were differences of opinion in the metallurgical world about various abstruse questions of theory as to the part, for instance, played by carbon in the production of steel. The part of the question which particularly affected the University was the scientific aspect of metallurgy. He was told the other day by one of the most eminent chemists in Great Britain that it was in this branch of study in the observation of the changes which take place of metals—that we were most likely to find assistance in investigating those abstruse problems which at present occupied science and which formed part of the discussions at the British Association ; such, for instance, as the changes which metals undergo by the possible transmutations of those substances which were now, perhaps, incorrectly called elements. It must be always a source of gratification to any University and to those engaged in education to consider that the subjects which they handled were not only of practical utility, but that they also tended to throw a general light upon knowledge which might lead to great discoveries in the future and to future conquests.

ADDRESS OF THE PRESIDENT

The President, in acknowledging the welcome accorded to the Institute said, that as a Sheffield man it was a great pleasure to him to have realised the wish that the Institute should visit a city that had devoted itself for so many centuries to the manufacture and working of steel. Sheffield had indeed taken a large and important position in the development of steel and its application. Although Bessemer was not a Sheffield man, the first practical developments of his process might be truly said to have taken place in Sheffield. Mr. Allen, of Bessemer's firm, also largely helped in the practical development of this method of steel making, and the inimitable Holly, from whose work the enormous development of Bessemer steel in America largely arose, did not go to South Wales or elsewhere, but came to Sheffield to be initiated, so that Sheffield might be rightly said to have taught America how to make steel rails used in those lines of communication that have entirely altered the whole face of the vast Transatlantic Continent.

In the same manner as regards the Siemens' process, firms such as Vickers' were largely instrumental in leading to the more rapid development and perfection of this method of producing steel, while such men as Mark Firth, William Jessop, Charles Cammell, and others, were other notable pioneers.

On the scientific side he must refer to Dr. Sorby, who has rendered invaluable service to metallurgy by his initiation, as far back as 1857, of methods of examining the micro-structure of metals. To-day Sheffield had probably the largest industrial army of any city devoted to the production and working of steel, 30,000 men or more being employed. It is with great satisfaction that he presided over this Institute at a time when trade prospects seem so much better in every country. The work done by this Institute spoke for itself and as a sign of prosperity he might state that they had to-day elected something like 150 new members, bringing the roll call to the satisfactory grand total of no less than 2,200 members. Judging, too, by the increasing size of the volumes the Institute accumulated records research and practical contributions to an important extent. The reading of papers was then proceeded with. (See page 713.)

VISITS TO WORKS, ETC

After luncheon at Cutler's Hall, by the invitation of the Reception Committee, members had an opportunity of visiting the University Metallurgical Department.

By the kind permission of the City Council, Weston Park and the Museum and Mappin Art Gallery were reserved for members of the Institute, selections of music being rendered and tea provided by the reception committee.

THE UNIVERSITY METALLURGICAL DEPARTMENT.

The department of metallurgy of the University of Sheffield has had special attention paid to it, seated as it is in a city where the chief national metallurgical industry is carried on. As a natural consequence of this, so far as iron and steel metallurgy is concerned, the metallurgical laboratories of the University of Sheffield are unique. These laboratories are divided into two sections, the scientific and the practical.

There are nine scientific laboratories; four of these are chemical assay laboratories, accommodating 102 students at one time. The mechanical laboratory is provided with a 50-ton static testing machine of the straight lever type, with two centres. Tensile, compressive, transverse, and torsional stresses can be registered on this machine in either 3-ton or 12-ton moments. There is also an alternating-stress testing machine, working up to nearly 800 alternations per minute.

The micrographical laboratory contains a battery of six 4-in. polishing blocks, run electrically, and nine microscopes, including the latest Zeiss photo-micrographic installation, illuminated by a powerful Nernst lamp. The photographic laboratory affords accommodation for twelve students working at one time. The pyrometer installation includes a central station Le Chatelier pyrometer, a portable photometric dial pyrometer, two optical pyrometers, and a modified air pyrometer. The geological laboratory contains a set of petrological microscopes, also rock-section cutting and polishing appliances. The practical laboratories are two in number. There is a crucible steel house in which the coke-melting process is employed; also apparatus for the manufacture of white crucibles, and a reverberatory furnace for annealing steel.

The chief practical laboratory contains a two-ton Siemens furnace, a one-ton Bessemer converter, and a gas-melting plant for six full-sized crucibles. It has also a hydro-carbon annealing muffle, a half-ton pneumatic hammer, and a 40-in. cupola for cast iron. The whole of the motive power is electrical, including a 4-ton travelling crane, commanding the foundry; there is also a 20-ft.-tons falling weight apparatus. Students are thus able to experiment on a manufacturing scale (40 tons of ingots and castings have been made in this laboratory during the present session), and to examine scientifically the metals they have made, using chemical, mechanical, physical, and microscopic methods.

THE WORKS OF THE SHEEPBRIDGE COAL AND IRON COMPANY, LTD., NEAR CHESTERFIELD.

To the managing director, Mr. M. Deacon, we are indebted for the excellent view of the above works appearing on page 674.

The iron-works comprise one blast-furnace 70 ft. high, automatically charged on the latest American principles, and six ordinary Derbyshire furnaces 52 ft. high. The output of pig iron is about 70,000 tons per annum of foundry and forge iron.

There are eight stoves, of the Whitwell and Cowper type, and four blast-engines. The rolling mills, where bar-iron and steel rails and steel sections are raised, is capable of turning out about 20,000 tons per anumn. Any kind of section is rolled up to angles of 4½ in. by 4½ in., and special qualities of rounds are made, from which chains for use by the Admiralty and for other special purposes are manufactured. Steel rails for colliery use are rolled up to 28 lb. per yard, together with iron sections of all descriptions up to 40 lb. per yard, including all kinds of railway wagon material.

There are large foundries connected with the iron-works, amongst them three large pipe-shops making spigot and socket pipes from 1½ in. diameter up to 48 in. diameter. This plant, with its numerous crane and other motors, is driven entirely by the waste gases from the blast-furnaces, used direct in gas-engines. It has been at work for four or five years without any failure and has given entire satisfaction.

In the jobbing foundry, castings of all descriptions are made, and a large quantity of tunnel-plates for the London underground railways, tubbing for colliery purposes, and railway chairs for the principal railway companies are constantly in process of manufacture.

In the fitting-shop department haulage machinery of various kinds for colliery purposes in constructed, together with other general engineering work. The visitors had an opportunity of inspecting Wadkin's Patent Mechanical Woodworker in operation.

From its inception to the year 1892 the affairs of the company were conducted by the late Mr. J Stores Smith, as managing director, and in 1896 Mr. Maurice Deacon was appointed general manager, and subsequently managing director, which position he now holds.

Mr. W. B. M. Jackson, late of the Clay Cross Company, was appointed general manager from January 1st, 1905, in association with Mr. Deacon. Mr. John Hall, the secretary of the company, still continues to fill that position. The works manager is Mr. H. Pilkington.

THE BRITANNIA WORKS OF MESSRS. J. HOPKINSON AND CO., LTD., HUDDERSFIELD.

A large party of the members of the Iron and Steel Institute left Victoria Station, Sheffield, in saloon carriages at 12.30 on Tuesday afternoon for Huddersfield for the purpose of visiting the new works of Messrs. J. Hokpinson and Co., Ltd. Huddersfield was reached after a forty-five minutes' run, and special trams were found waiting to take them to the works, where they were received by the directors. The party immediately sat down to a sumptuous lunch, at the conclusion of which the toast of the "Firm" was given by the Mayor of Huddersfield, Mr. Benjamin Broadbent, Mr. Joseph Hopkinson, Chairman of the Company, responding. A tour of the works was subsequently made.

THE LATEST NOTE IN ORGANISATION.

Messrs. J. Hopkinson and Co., Ltd., as is generally known, have for the last sixty years been engaged in the manufacture of high-class boiler mountings, and valves for pressures up to 400 lb. per square inch. Their first works were established in 1843 in the centre of the town, and as the business developed, were extended from time to time. As, however, a short time ago it was found impossible to maintain the output at the rate of demand, after careful consideration, it was decided to erect new works. A site was acquired in one of the residential quarters in the outlying suburbs, and a very careful investigation of the plans adopted by firms under similar conditions was made. Many works in different parts of the country were visited by the directors in order to ascertain every latest practice. It was therefore with very lively anticipation that the members of the Iron and Steel Institute looked forward to this visit, because it was realised they would see the latest note struck in the layout and organisation of a modern engineering establishment. Nor were they disappointed.

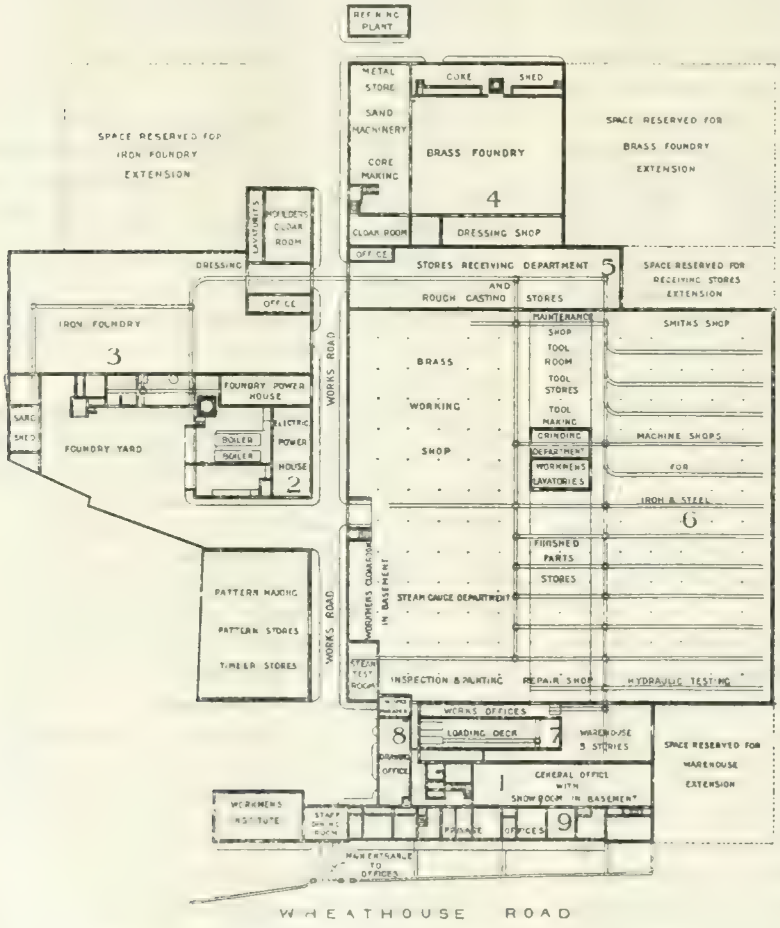


FIG. 1. GROUND PLAN OF HOPKINSON'S VALVE FACTORY.

(1) Showroom, (2) Power house, (3) Iron foundry, (4) Brass foundry, (5) Receiving and casting stores, (6) Machine shop, (7) Shipping department, (8) Drawing and designing department, (9) Administration block.

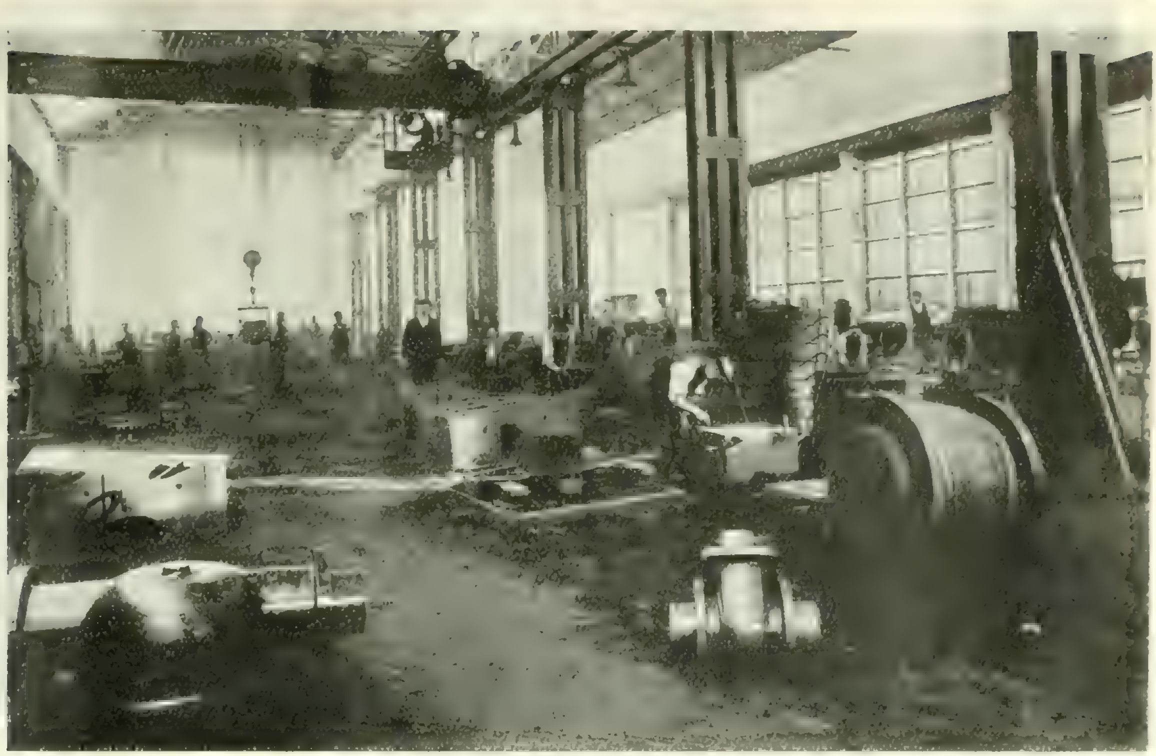


FIG 2. THE IRON FOUNDRY.

THE IRON FOUNDRY.

On entering the iron foundry (which is illustrated in fig. 2), the splendid light and height of the buildings, and the manner in which the foundry was equipped, were especially noticeable. It has two bays 40 ft. long by 80 ft. wide, with a moulding floor space of 16,000 square feet. The cupola is accommodated in an annex, there being a hydraulic lift to the charging platform. There are several sand-preparing machines in the foundry, and the usual core-drying stoves, etc. The overhead electric crane is of six tons capacity. The comfort of the employees has been fully considered, a large room being provided with lavatory basins and clothes hooks.

BRASS FOUNDRY.

Crossing the main road the brass foundry was reached, which is illustrated in fig. 3. This is a building 100 ft. long by 40 ft. wide. The foundry is provided with annexes for the storage of coke and dressing castings. Leaving the brass foundry the machinery and castings stores, which are 180 ft. long by 40 ft. wide, were next visited. There the brass and iron castings made in the works and supplies obtained from other firms are received. The firm make it a rule that all materials to be formed into one or other of the specialities manufactured, enter the works through this department. Here they are carefully inspected before being distributed to the various machines. A tramway running from the far end of the iron foundry across the main road and traversing the whole length of these stores, with branch lines, serves the purpose of redistribution.

MACHINE SHOP.

The machine shop was then entered and the visitors were greatly impressed with the cleanliness of the shops and the order which prevailed. The machine shop is 280 ft. by 260 ft., with a floor space of 72,800 square feet. It is divided into two bays of 20 ft. for the full

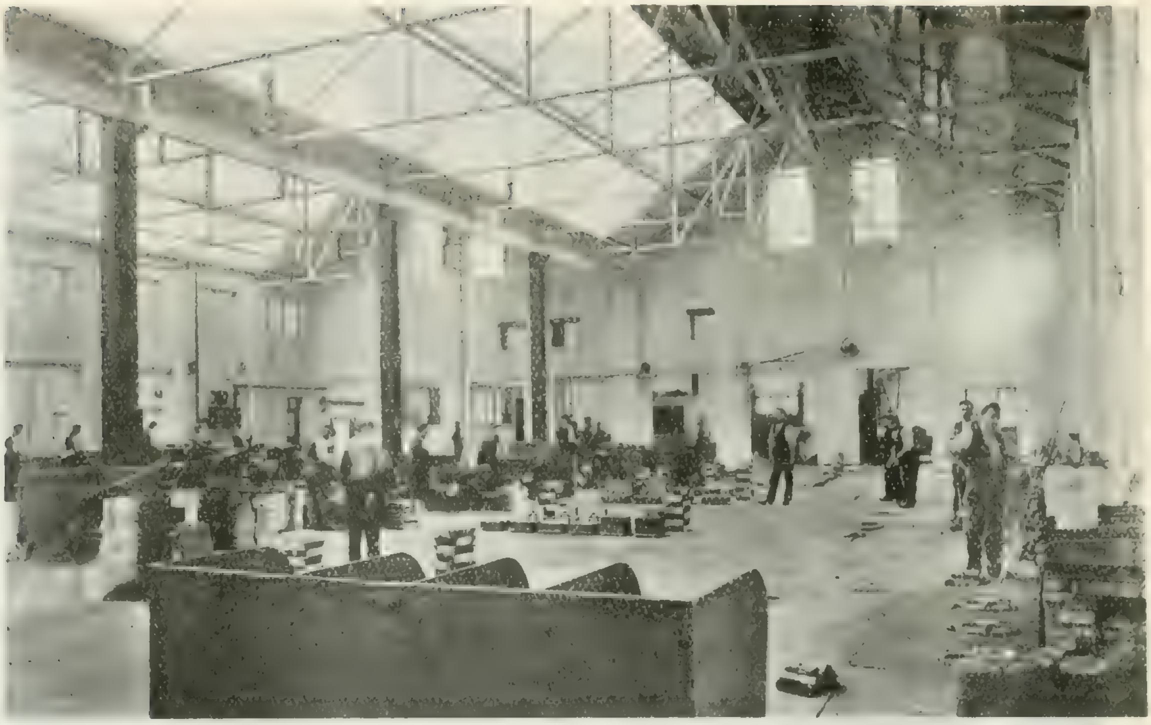


FIG. 3. BRASS FOUNDRY.

length of 280 ft. The roof is of the saw-tooth type glazed on the northern slope and painted inside with a pale blue on the slated top, which reflects a soft and pleasant top light into the shop. The machine shop being in direct communication on the one side with the casting stores and on the other with the warehouse and shipping departments, is in the best situation for dealing with the machinery of the work in progress, as also for the inspection and delivery of finished goods (see figs. 4, 5, 6, 7, 8 and 9).

The machine shop is divided into two main sections known respectively as the "Iron and Steel" and the "Brass" side. As will be see from the plan (fig. 1), midway between these two main sections are situated the maintenance department, tool room, grinding and polishing room, and the finished part stores and lavatories which are common to both sections. Each bay in the shop is designated by a letter and the tools for each distinctive process are grouped in their respective bays. Thus on the "Iron and Steel" side there is first the smiths' shop, then the heavy turning and boring bay, the planing and milling bay, the drilling bay and small turning, and so on. Special hydraulic appliances are fixed at many convenient points for testing at various stages of manufacture, so that no defective part can possibly go forward to a later operation without being detected, thus securing reliability.

On the "Brass" side, are various types of brass-finishing machines and special plant designed for dealing rapidly with large quantities of work, and at a point convenient to both sides is a large steam testing department through which work passes, and where a boiler steaming daily, and capable of supplying steam for testing purposes up to 400 lb. per square inch, is placed.

On this side also is a temporary pattern shop with a modern equipment of the latest woodworking tools, together with space allotted for carpenters' and packing-case making.

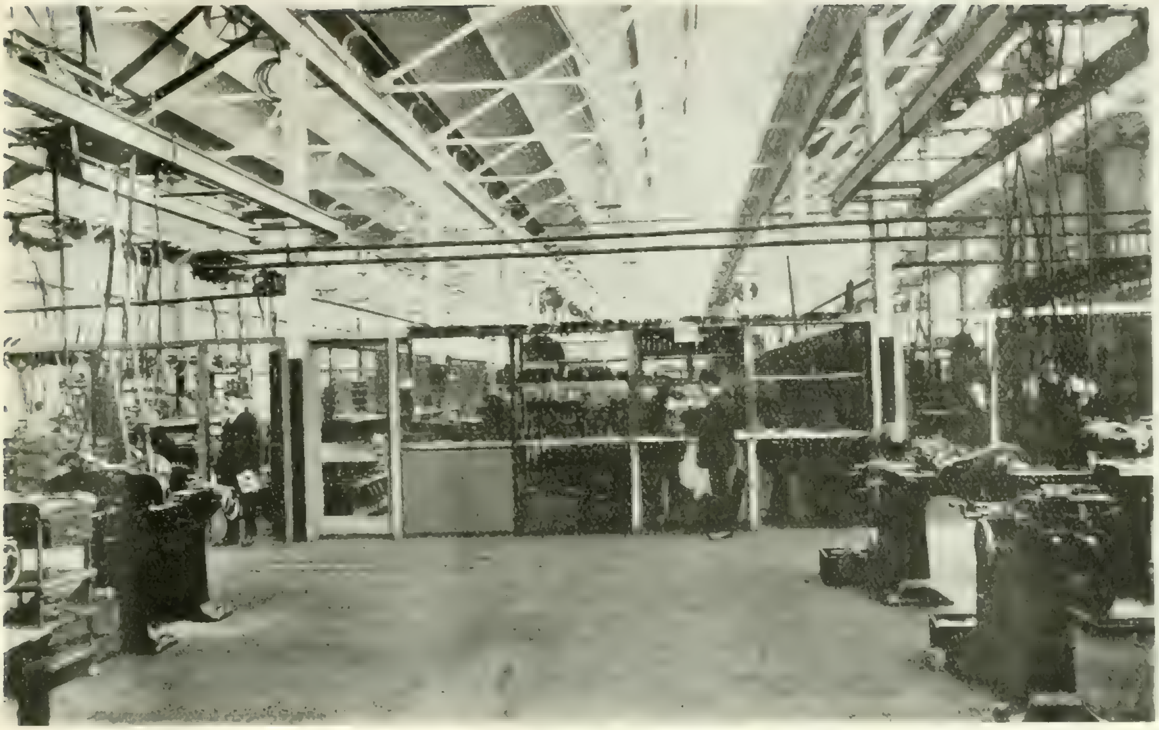


FIG. 4. MACHINE SHOP—MAINTENANCE AND JIG MAKING, TOOL STORES, AND TOOL GRINDING.

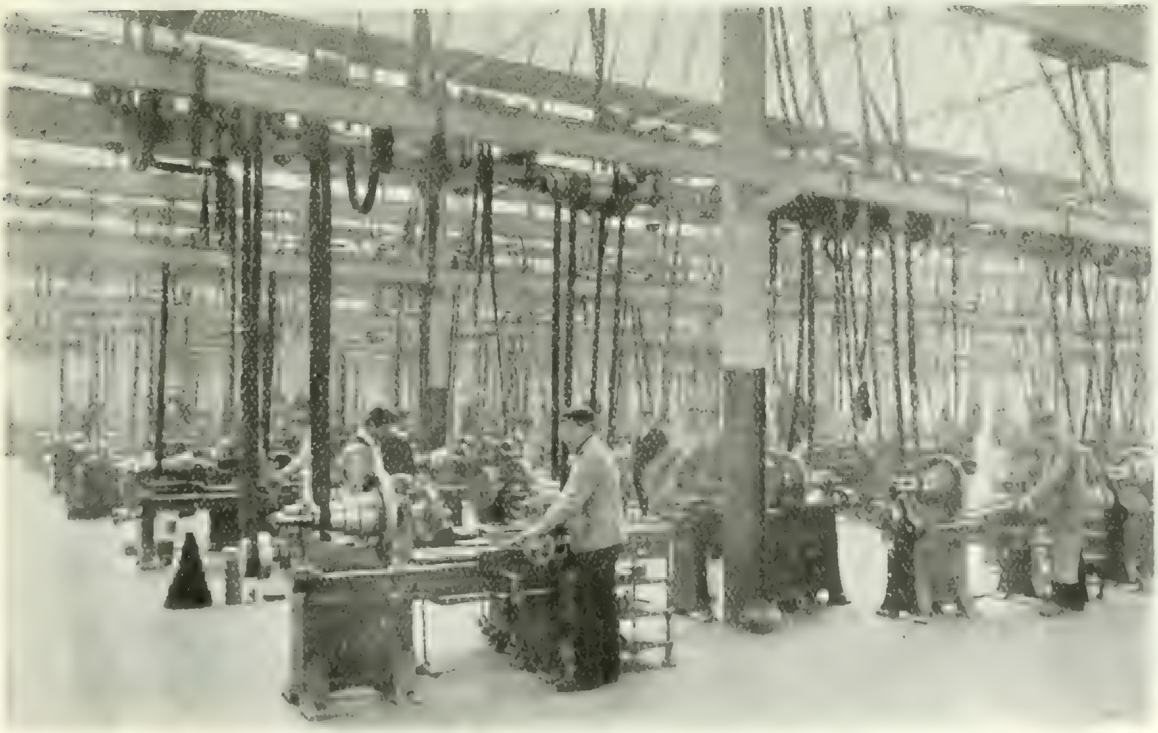


FIG. 5. VIEW IN PORTION OF MACHINE SHOP—[illegible]

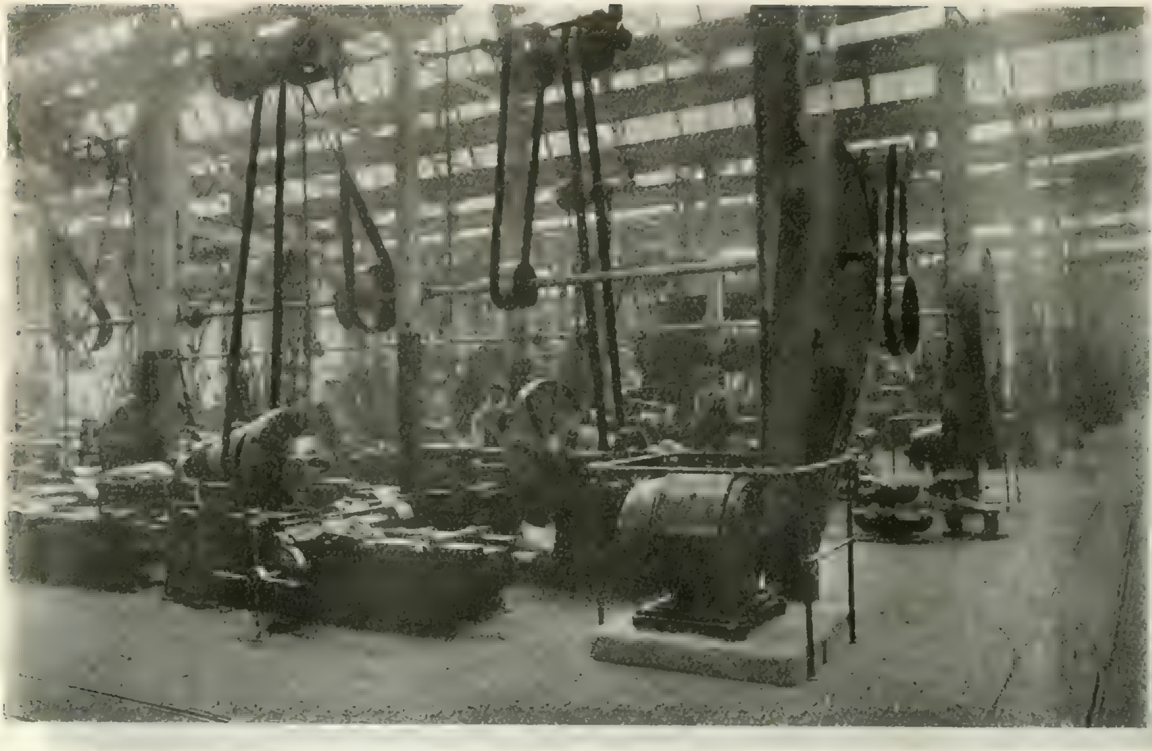


FIG. 6. GANGWAY IN MACHINE SHOP, IRON AND STEEL SIDE, SHOWING SYSTEM OF MOTOR DRIVING AND TRAMWAYS.

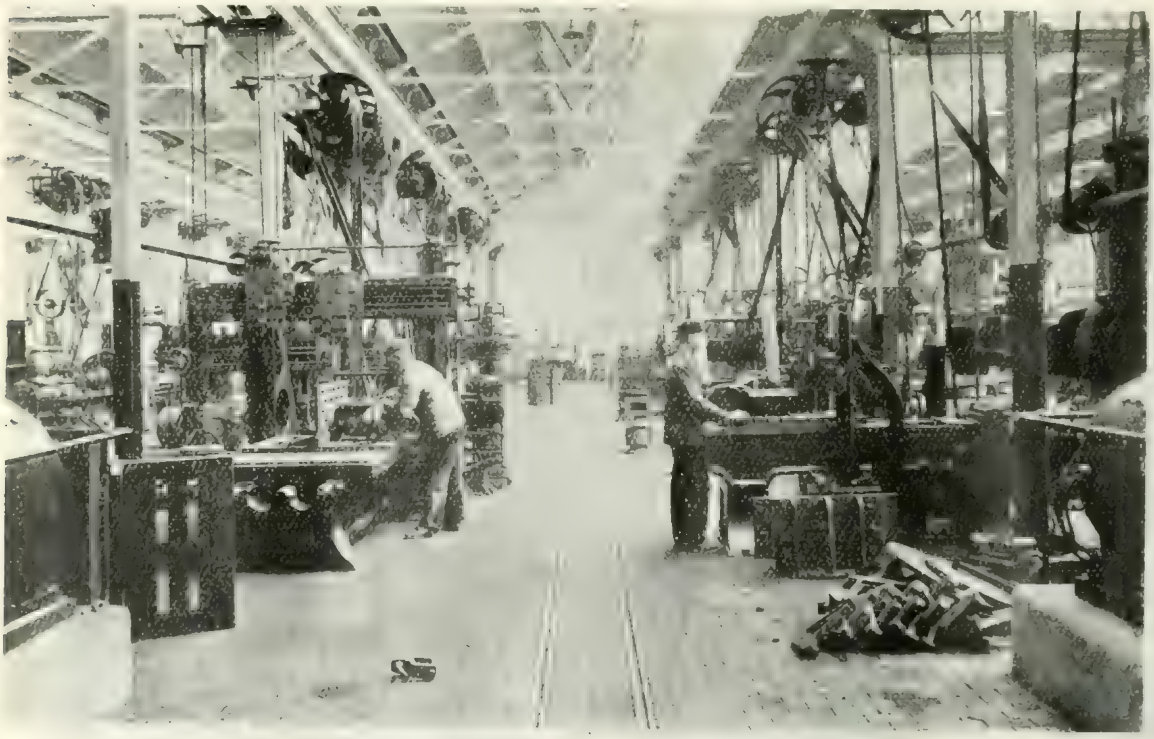


FIG. 7. MACHINE SHOP, IRON AND STEEL SIDE - PLANING AND MILLING, BAY E.

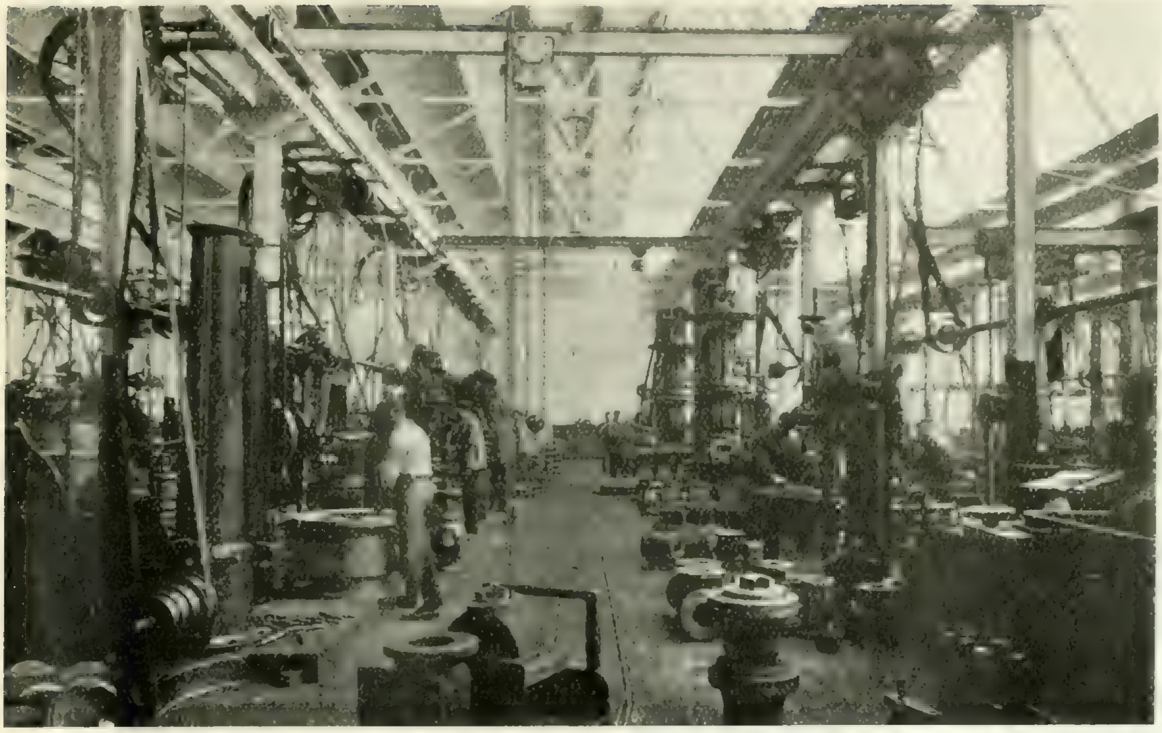


FIG. 8. MACHINE SHOP, IRON AND STEEL SIDE—DRILLING, BAY F.

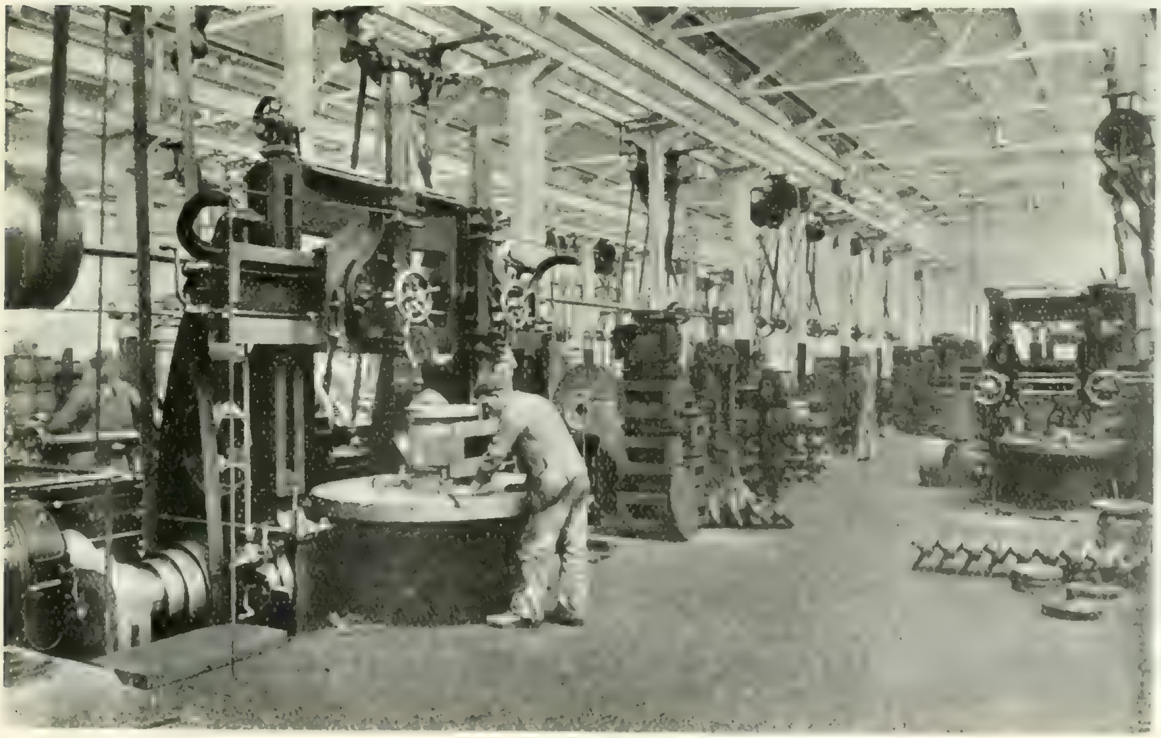


FIG. 9. MACHINE SHOP, IRON AND STEEL SIDE—VERTICAL TURNING AND BORING MACHINES.

From the machine shop the visitors passed to the warehouse and shipping department, (see fig. 10). This is 160 ft. long by 40 ft. wide, with two galleries running round three sides giving a total floor space of 20,000 square feet. There are electric hoists communicating with the galleries. The ground floor is on the same level as the machine shop, which at this point is considerably higher than the level of the ground outside. This greatly facilitates the loading of the manufactures on to the railway lorries, as when they are backed on ground level into the loading department, the deck is level with the floor.

THE ADMINISTRATIVE OFFICES.

Entering the administrative offices the drawing department (see fig. 11) was inspected. This is a spacious and well-lighted room. Immediately above is the printing room, where blue prints of drawings are taken by means of the arc light for the workshop, stationery stores and designing departments, and lecture rooms for instruction to the staff in the working of high pressure boilers and steam plant. The works' offices are at the end of the drawing office and are in close touch with the chief draughtsman and the works manager, and in such a position that they can overlook all the main shops.

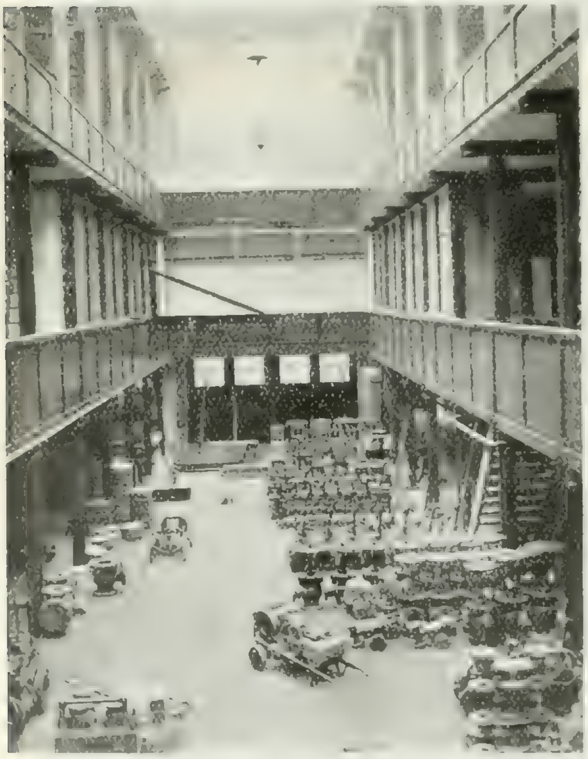


FIG. 10. CENTRAL WAREHOUSE AND SHIPPING DEPARTMENT.

The general offices, illustrated in figs. 12, 13 and 14, were finally arrived at, which comprise all the important departments both commercial and technical.

The general arrangement is a large hall, overlooking which are the directors' offices, and also adjacent are other secretarial board rooms and patents library, etc. The arrangement has been designed to facilitate easy communication between the different departments with the least possible trouble. All departments throughout the factory are connected by telephone. The order and shipping departments are so arranged as to be adjacent to the warehouse and shops.

The card system is adopted throughout the works, a uniform size of 3 in. by 5 in. card being preferred. Practically no instructions pass from the office to the foremen or from the foremen to the men, or to the tool rooms, except by means of such cards. We publish two specimens of these (fig. 15), which were handed to our representative at the time of the visit.

HOURS OF WORKING.

The foundry hours are arranged on the "one-break" system. The hours of working commence at 7.30 a.m., the workmen partaking of their breakfasts either at home or in the foundry mess-rooms before starting. Only one stop is made during the day, between 12.30 and 1.30 p.m. For the interest of our readers we reproduce the poster (fig. 16), which is exhibited in various parts of the buildings and fully explains this system. It will be noticed that

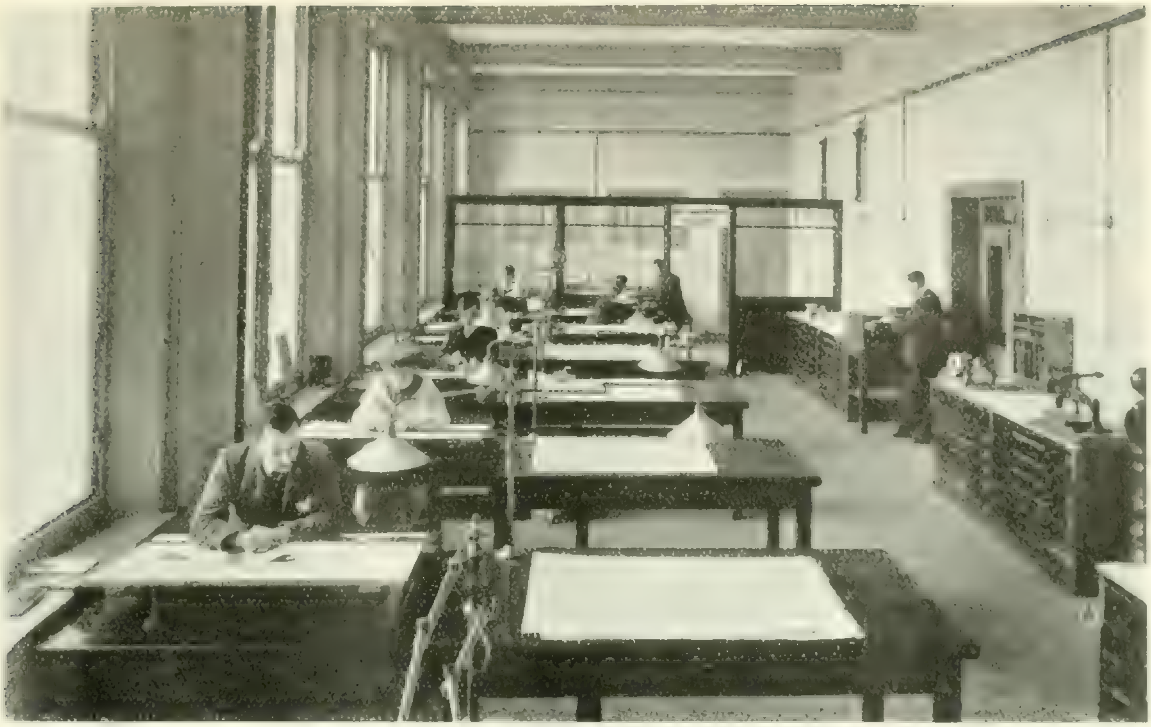


FIG. 11. DRAWING DEPARTMENT.

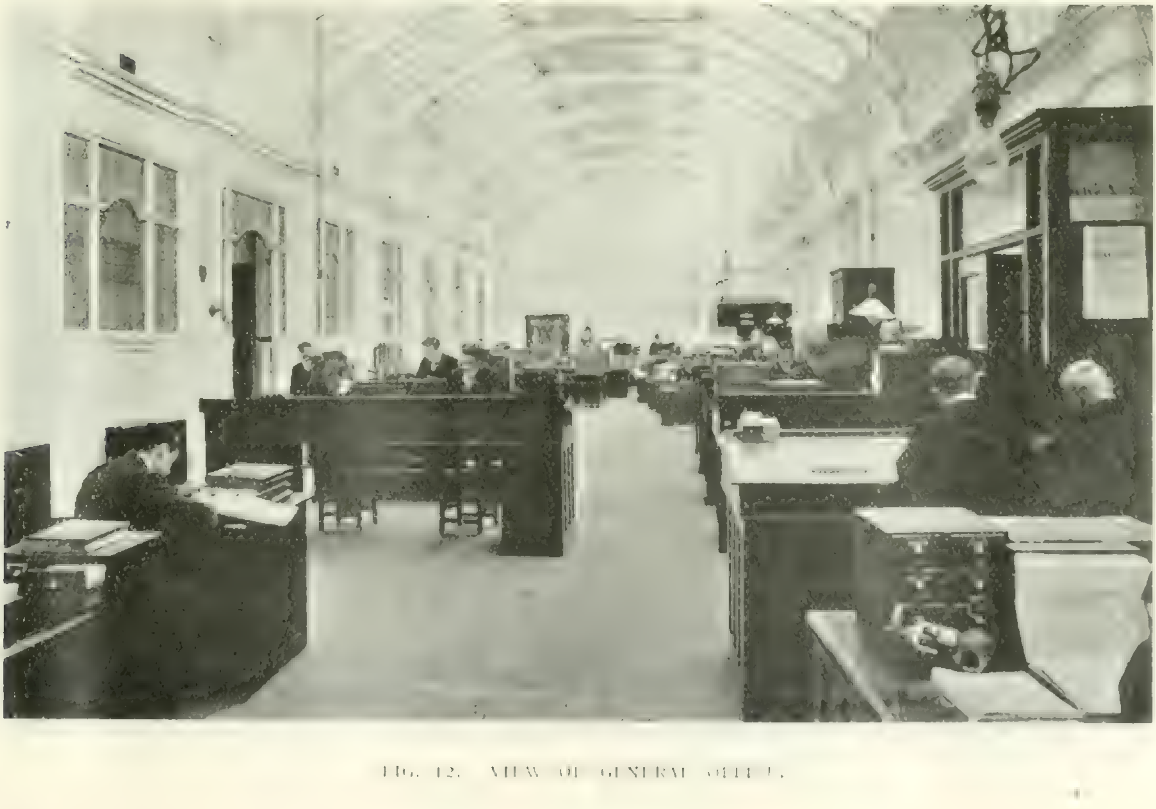
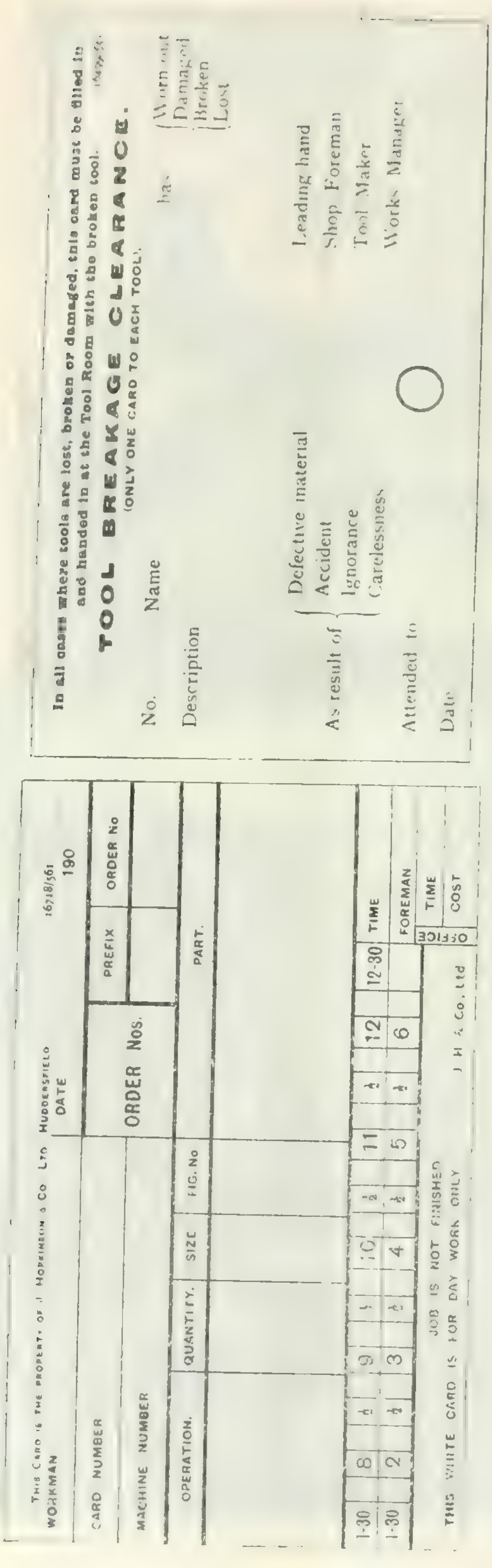


FIG. 12. VIEW OF GENERAL OFFICE.



In all cases where tools are lost, broken or damaged, this card must be filled in and handed in at the Tool Room with the broken tool.

TOOL BREAKAGE CLEARANCE.

(ONLY ONE CARD TO EACH TOOL).

No. Name has {Worn out / Damaged / Broken / Lost}

Description

As result of {Defective material / Accident / Ignorance / Carelessness}

Leading hand
Shop Foreman
Tool Maker
Works Manager

Attended to

Date

THIS CARD IS THE PROPERTY OF J. HOPKINSON & CO LTD HUDDERSFIELD 16718/561

WORKMAN DATE 190

CARD NUMBER

ORDER Nos. PREFIX ORDER No

MACHINE NUMBER

OPERATION. QUANTITY. SIZE FIG. No PART.

1-30	8	½	9	½	10	½	11	½	12	12-30	TIME
1-30	2	½	3	½	4	½	5	½	6		FOREMAN

JOB IS NOT FINISHED

THIS WHITE CARD IS FOR DAY WORK ONLY

J H & Co. Ltd

OFFICE TIME COST

FIG. 15. TWO FORMS OF CARD IN USE AT THE FACTORY.

the working week is 52½ hours, but where the men put in this full time for day work (exclusive of overtime) they are granted a bonus of 1½ hours' wage at the rate of 54 hours per week; so that for the full 52½ hours they secure a wage for a 54-hour week. This bonus has been beneficial to the firm by ensuring a full working week in a greater number of cases than formerly.

The gates are closed two minutes after the time for resuming work, but the time for the ordinary wage and for the winning of the bonus is reckoned from the moment the men register themselves upon the automatic time registers, and these are located in each department, and therefore within a very short distance from most of the workmen's posts. Dining-rooms have been arranged with special gas-cooking stoves, where the men's food is warmed, and a man is in constant attendance. A large number of the employees ride to and from their work on bicycles. A room with suitable racks is provided and the machines are taken care of while the men are at work. With a view of encouraging cleanliness in the works, there are distributed up and down the shops, wire baskets at various points, as receptacles for waste paper, and each man is provided with a rack for putting his work on instead of its being thrown about the floor.

In training their men to be methodical, the firm consider it to be a good investment, as an unthinking workman breaks costly tools and spoils costly material; whereas the workman who is taught to use his faculties makes fewer mistakes, and turns out better quality and a larger quantity of product.

The works are run entirely by electric power and the central station is illustrated in fig. 17.

THE ELECTRICAL PLANT.

The electric power-house is steam driven from two large boilers generating steam at 180 lb. pressure, two only being required at the same time for even the heaviest electrical load. There are two direct coupled plants; one large and one small. The larger one consists

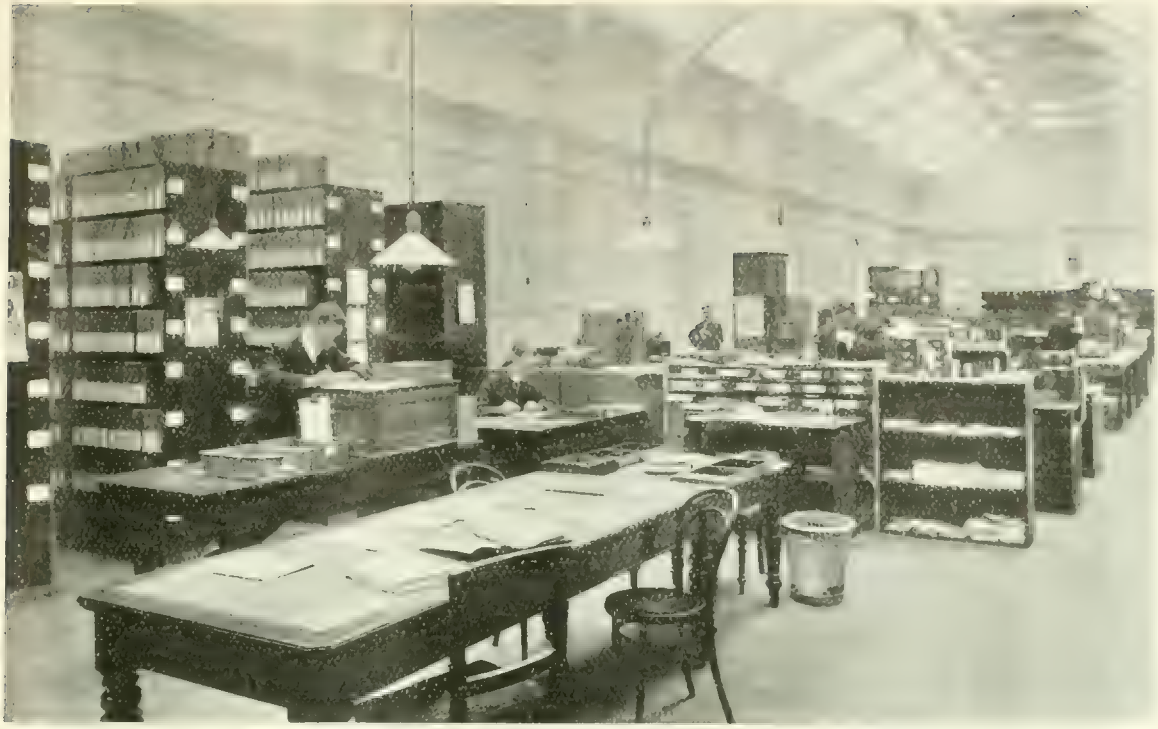


FIG. 13. GENERAL OFFICE—LETTER FILING AND MAILING DEPARTMENT.

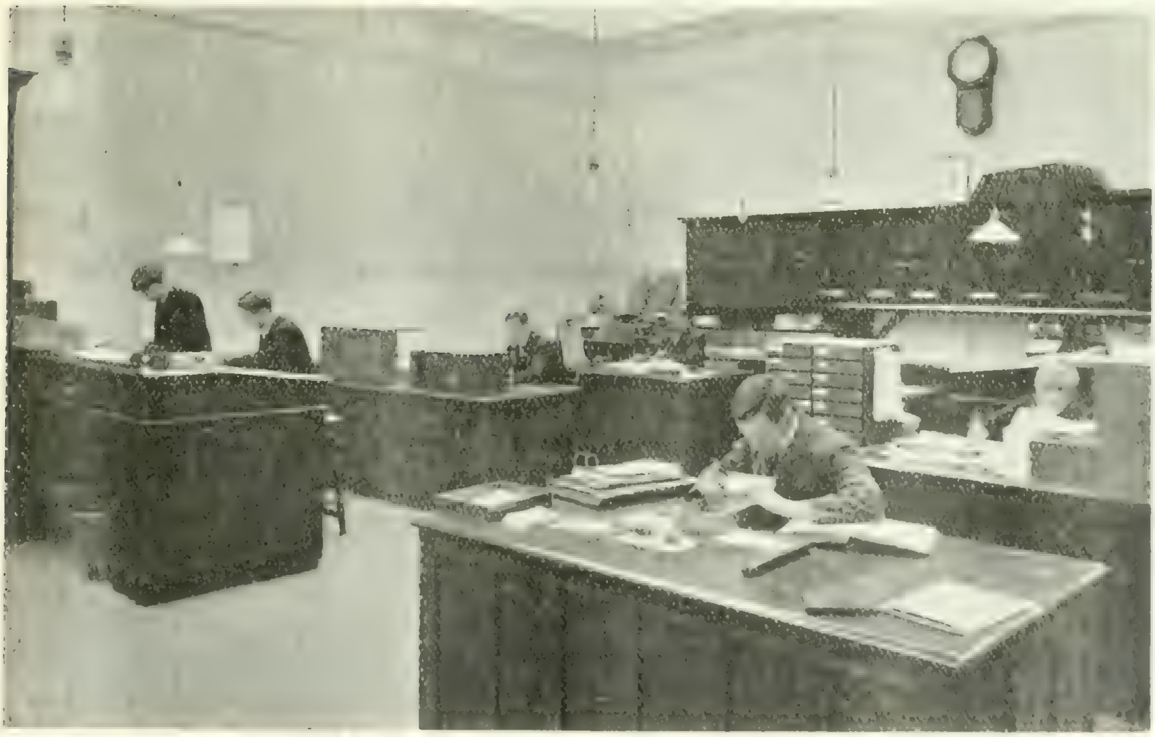
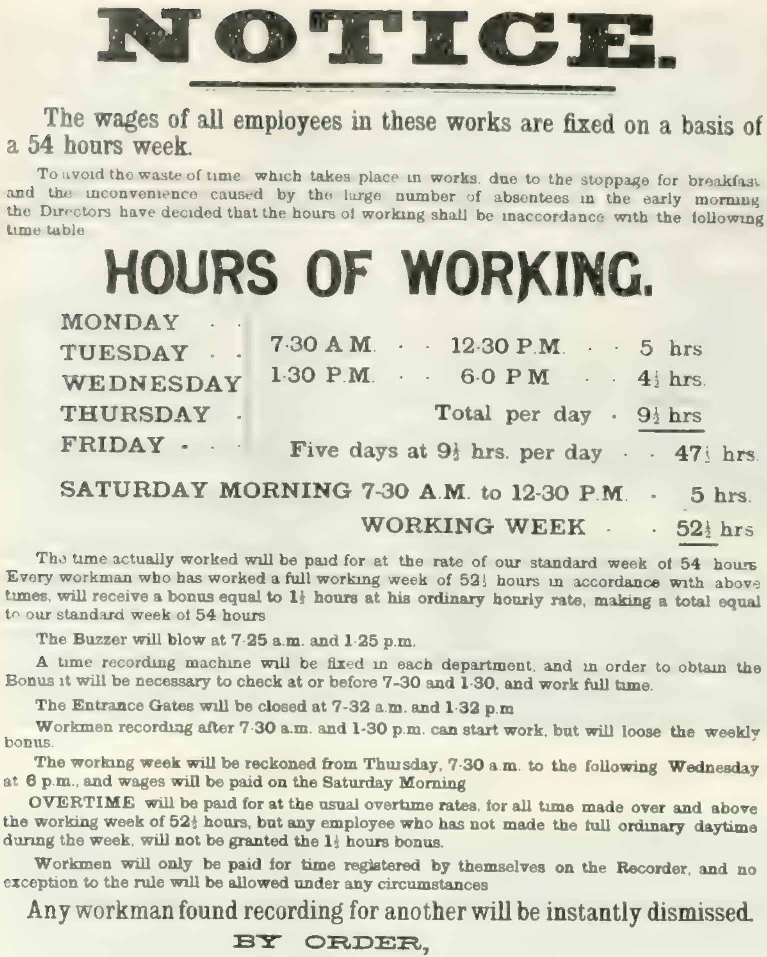


FIG. 14. GENERAL OFFICE—COSTS DEPARTMENT.



NOTICE.

The wages of all employees in these works are fixed on a basis of a 54 hours week.

To avoid the waste of time which takes place in works, due to the stoppage for breakfast and the inconvenience caused by the large number of absentees in the early morning the Directors have decided that the hours of working shall be inaccordance with the following time table

HOURS OF WORKING.

MONDAY
TUESDAY . . 7·30 A.M. . . 12·30 P.M. . . 5 hrs
WEDNESDAY 1·30 P.M. . . 6·0 P.M. . . 4½ hrs.
THURSDAY . Total per day . 9½ hrs
FRIDAY . . . Five days at 9½ hrs. per day . . 47½ hrs.

SATURDAY MORNING 7-30 A.M. to 12-30 P.M. . 5 hrs.
WORKING WEEK . . 52½ hrs

The time actually worked will be paid for at the rate of our standard week of 54 hours Every workman who has worked a full working week of 52½ hours in accordance with above times, will receive a bonus equal to 1½ hours at his ordinary hourly rate, making a total equal to our standard week of 54 hours

The Buzzer will blow at 7·25 a.m. and 1·25 p.m.

A time recording machine will be fixed in each department, and in order to obtain the Bonus it will be necessary to check at or before 7-30 and 1·30, and work full time.

The Entrance Gates will be closed at 7-32 a.m. and 1·32 p.m

Workmen recording after 7·30 a.m. and 1-30 p.m. can start work, but will loose the weekly bonus.

The working week will be reckoned from Thursday, 7·30 a.m. to the following Wednesday at 6 p.m., and wages will be paid on the Saturday Morning

OVERTIME will be paid for at the usual overtime rates, for all time made over and above the working week of 52½ hours, but any employee who has not made the full ordinary daytime during the week, will not be granted the 1½ hours bonus.

Workmen will only be paid for time registered by themselves on the Recorder, and no exception to the rule will be allowed under any circumstances

Any workman found recording for another will be instantly dismissed.

BY ORDER,
J. HOPKINSON & Co., Ltd.,
BIRKBY.

FIG. 16. NOTICE TO WORKMEN.

of a Belliss and Morcom, two crank engine driving at 380 revolutions and a 275 kilowatt multipolar compound wound dynamo machine by the Electrical Construction Company. The smaller set includes a two crank engine driving at a speed of 450 revolutions and a 150 kilowatt multipolar compound wound dynamo machine by the Westinghouse Manufacturing Company. The large engine is capable of working up to 400 b.h.p. and the smaller one to 200 b.h.p. The current is generated at 220 volts at the main switchboard. The generating units are conveniently placed in a row so that all the electrical ends are under easy inspection from the switchboard, whilst the steam engines are able to draw their steam with a minimum of steam pipe in circuit. Above the plant is an overhead traveller enabling inspection and repairs to be quickly and economically effected.

SWITCHBOARD

The dynamo cables pass by means of earthenware pipes to a point behind the switchboard: the latter is built up on the Westinghouse panel system. The whole is constructed on a special system by means of which the iron work at the back of the marble slabs, is practically eliminated, enabling the connections to be carried more directly and safer from interruption, and securing very high and permanent insulation. The dynamo panels each consist of one triple pole main switch, one circuit breaker on the negative side and shunt resistances; there is also an ammeter one volt meter and unit meter for each machine.

The small cables are carried in steel conduit tubes to the various motors about the works, and are connected to a double pole switch and rheostat fixed on a polished teak board close by the motor. The motors are fixed at the end of each line of shafting in the iron and brass departments and consist of six 20-h.p. one 12 h.p., ten 10 h.p., and one 5-h.p. motors, both compound and shunt wound, by Westinghouse, Greenwood and Batley, British Thomson-Houston and Bruce Peebles.

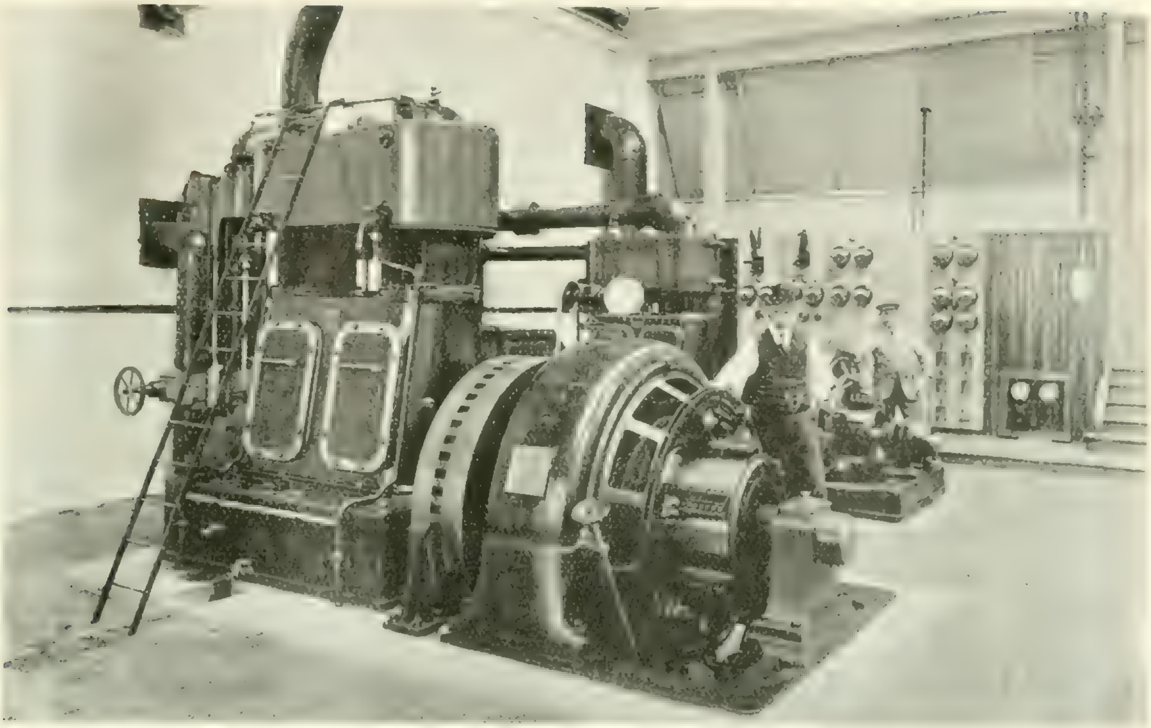


FIG. 17. ENGINE ROOM AT THE POWER STATION.

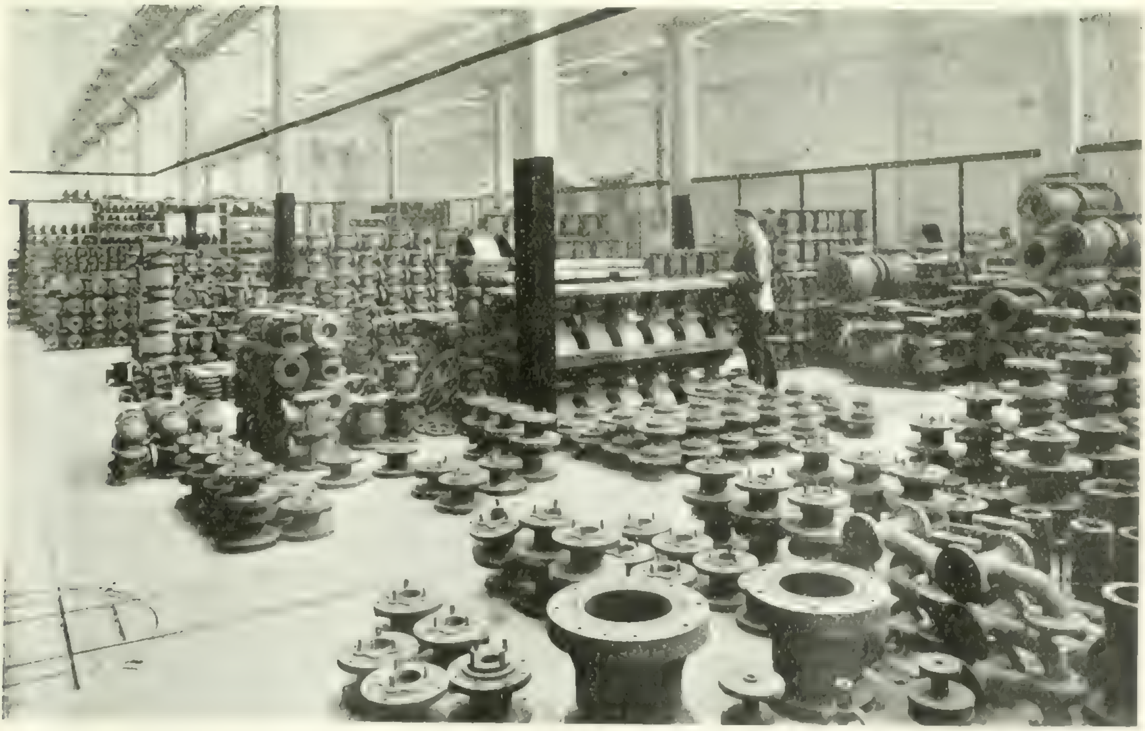


FIG. 18. FINISHED PART STORES FOR IRON AND STEEL VALVE BODIES, MADE AT THE BRITANNIA WORKS.

The lighting feeders are carried to three large distribution boards with double pole switches and fuses from them to sub-lighting board with double pole switches and fuses, consisting of polished slate slabs fitted with copper bus bars and enclosed in teak frame with glass door.

The works are lighted with about 160 enclosed Jandus arc lamps of 1,000 c.p. each run two in series. The general and private offices are lighted by incandescent lamps of 16 c.p. from the firm's own plant during working hours. After the works are closed a switch is changed over to the Corporation main.

There was a unanimous feeling amongst the visitors on the return journey that no effort had been spared to construct a foundry on the most modern lines with a view to producing the best possible article, and at the same time providing pleasant, healthy surroundings and working conditions for the staff and workmen.

Tuesday's proceedings closed with a brilliant reception by the Rt. Hon. the Lord Mayor and the Lady Mayoress at the Town Hall.

WEDNESDAY.

After the further reading and discussion of papers on Wednesday, members had the option of visiting the East Hecla Works of Messrs. Hadfield's Steel Foundry Company, Ltd., the Iron and Wire Rope Works of Messrs. W. Cooke and Co., Ltd., and other works.

VISIT TO THE EAST HECLA WORKS OF MESSRS. HADFIELD'S STEEL FOUNDRY COMPANY, LTD.

The guests at the above works were received by Mr. R. A. Hadfield and his co-directors, Mr. A. M. Jack, Mr. B. Freeborough, Mr. H. Cooper, and Mr. W. H. Dickson. Amongst those present were: His Excellency Señor Bernabe (the Spanish Ambassador), Marquis de Villalobar (Councillor of the Embassy and Chamberlain to the King), His Excellency Viscount Hayashi (Japanese Minister), who was accompanied by General A. Chaffee, Chief of the Staff, U.S. Army), Earl Fitz-William, Mr. Bonar Law, M.P., General Sir J. Wolfe Murray, K.C.B. (Master General of Ordnance), General D. O'Callaghan, C.V.O. (President of the Ordnance Committee), Captain H. B. Jackson, R.N., F.R.S. (Comptroller of the Navy), Colonel R. A. Montgomery, C.B., C.M.G., Sir G. S. Clarke, K.C.M.G., F.R.S. (Secretary of the Imperial Defence Committee), General R. H. O'Grady, Haly, Colonel R. Mahon, Captain Kaburak (Japanese Naval Attaché), Major Beacon (U.S. Naval Attaché), the vice-presidents and members of the Council of the Institute, including Messrs. E. Windsor Richards, E. Pritchard Martin, and W. Whitwell, Sir W. H. Bleckly, Sir John Alleyne, Sir E. H. Carbutt, Sir W. T. Lewis, Messrs. James Riley, A. Keen, G. J. Snelus, F.R.S., David Colville, J. M. Gledhill, A. Lamberton, J. E. Stead, F.R.S., A. T. Tannett-Walker, J. M. While and I. Williams.

At the conclusion of an enjoyable luncheon, presided over by Mr. R. A. Hadfield, Chairman of the Company and President of the Institute, the visitors proceeded to view the works. Adjoining the luncheon room was an interesting display of special electrical tramway appliances, including Hadfield's patent "Era" steel tramway points, crossings, and curved rails, also "Era" steel railway crossings.

An appliance early inspected was the portable petrol-driven machine, designed by the firm to enable the groove and tread of tramway trackwork to be ground after having been fixed in

COLLIERY TUB CONSTRUCTION AT THE EAST HECLA WORKS.

MESSRS. HADFIELD'S FORGE AND SMITH'S DEPARTMENT.

ANOTHER VIEW IN THE DEPARTMENT.

position, without in any way interfering with the running of the cars. The petrol motor employed is 4½ b.h.p. power, with water-cooled head, and a neat sheet-iron cover encases the working parts of the motor when not in use, to protect them from injury.

Another appliance prominently exhibited was Parr's patent automatic electrical point controller, with which readers of PAGE'S WEEKLY are already familiar.

Concerning Le Rossignol's patent unbroken main line crossover, it was explained that it has been specially designed to reduce the number of joints, points, and crossings on the main line, and thereby give the maximum amount of through running rail. It is especially suited for emergency crossovers, especially in residential districts, as it avoids the continual clatter and noise experienced when ordinary points and crossings are used. The crossover consists of a set of six ramp casting, which, when not required, are neatly contained in a box which is fixed adjacent to the rails.

TRAMWAY AND RAILWAY LAYOUT DEPARTMENT.

One of the most important departments at these works is that devoted to track construction, chiefly for light railways and tramways, although to a large extent standard gauge railway track is also dealt with. The special qualities of "Era" steel, which, as is well known, Mr. Hadfield was the first to introduce, render it particularly suitable for points and crossings, and other special track work.

In order that all crossovers, junctions, etc., may be fitted together before leaving the works, the firm have a layout floor, completely boarded, of about five acres. It is equipped with the latest electrically-driven machine tools for bending, sawing, and drilling rails.

(*Continued on page* 709.)

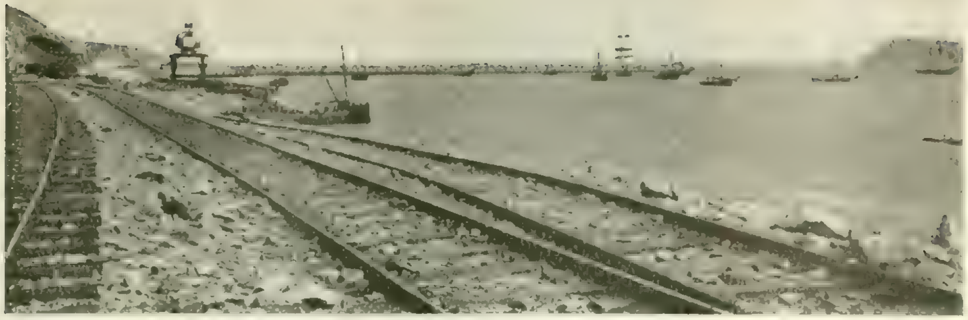


FIG. 2. FISHGUARD HARBOUR WORKS SHOWING BREAKWATER IN COURSE OF CONSTRUCTION AT GOODWICK.

FISHGUARD HARBOUR WORKS.

WE illustrate in this issue the works in progress at Fishguard, Pembrokeshire, where the Great Western Railway Company are constructing a harbour in connection with a scheme for expediting transit between England and Ireland. The project is a very old one, the first proposal to construct a pier at Fishguard dating back to 1790. Interest in Fishguard was revived in 1893 when the Fishguard Bay Railway and Pier Company obtained powers to construct a harbour there, and connect it with a short railway that had in the interval been projected. In 1894 the same company and others interested obtained further powers.

Ultimately the English Great Western and the Irish Great Southern and Western Railway Company joined forces with the object of obtaining joint control, and under this powerful combination there have been important developments at Fishguard and at Waterford, and when the works are completed, it will be possible to arrange a satisfactory time table between London and Cork, Killarney and the south and west of Ireland. Fishguard Bay possesses several advantages as a point of departure for the sea passage on this service. It has easy access from the sea, a small tidal variation, a good depth of water, and a practical freedom from fog. The railway and harbour works now being carried out are shown in the enclosed plan, and for this and other illustrations as well as for details of the work, we are indebted to the courtesy of the Great Western Railway Magazine.

The construction of the works was commenced some nine years ago by Mr. I. J. Mann, who acted as resident engineer, under Mr. James C. Inglis, when they were taken over by the present company in 1898. They were carried on tentatively with a small amount of plant, but a considerable number of men, for six years. The start was a difficult one, as precipitous cliffs of intensely hard vitreous rock, varying in height from 100 to 200 ft., and washed by the sea, represented all the ground the men had to work upon.

At a later period Mr. Inglis decided that more steam machinery was necessary to construct a harbour in reasonable time, and placed Mr. G. Lambert Gibson, M.Inst.C.E., in charge of the design and construction of the works. A complete installation of compressed air drilling plant was put down, and a contract let to bore holes in the rock and blast it down. Two methods [illegible] boring holes up to 20 ft. deep and 2½ in. diameter, into [illegible] the rock exceptionally hard. A tunnel some 40 ft. long is driven square into the face of the cliff, with two branches, also of about 40 ft. each, right and left of it, forming a T shape. At the ends of the cross-tunnels small chambers are made; in these are placed two boxes, containing seven tons of gunpowder; the tunnels are then built up and the charges fired by electricity.

FIRING THE MINES.

In figures 3 and 4 is shown the firing of one of the mines, which brought down 40,000 tons of rock at a place where the cliff was 120 ft. high, the slice of rock detached being some 40 ft. thick. The rock having been blasted down, is loaded by 14 steam travelling cranes of powers varying from [illegible] tons to 15 tons, into wagons. Stones from 3 to 15 tons weight are tipped on the sea side of the breakwater; those from 1 cwt. to 3 tons being used to form its harbour side, and also for the filling required for the quay and sidings. Stones of 1 cwt. and less are sent to a ballast crusher, which supplies screened ballast, and provides the chippings and sand for the making of concrete blocks for the quay wall; while quarry rubbish and surface mould is sent to the Goodwick station-yard as filling to form the site for sidings, carriage and engine sheds there.

The whole of the rock thus loaded is passed over a weigh-bridge, and a record kept of the amount loaded by each crane; an average day's loading is 1,500 tons, though on several days the 2,000 tons mark has been passed. By far the greater portion goes to the breakwater, which, being 70 ft. wide at the top, [illegible] ft. wide at the bottom and 70 ft. deep from top to the bed of the sea, takes some 650 tons to make each foot of its length. It has now reached out to 1,400 ft. from the land, and is advancing to its 2,000 ft. length at the rate of 10 ft. per week.

The quay wall 50 ft. deep is being built of 4,900 concrete blocks ranging in weight from six to ten tons. A trench is excavated by a suction dredger, and the shingle is taken off down to the rock, which is then levelled so that an even foundation is obtained upon which the blocks are lowered.

NEW BALLAST CRUSHER.

The ballast crusher employed is the first of its type put down by any British railway company. It is known as the gyratory type, and is somewhat similar to a coffee mill, except that the mill part does not rotate, but "wobbles." Rock, tipped into a large hopper, passes through the jaws being reduced down to 2 in. size, when it drops into a 70-ft. elevator, which carries it to a large rotary screen. The screen takes out the ¾-in. chippings, the 2-in. stones drop into large bins capable of holding 400 tons under which empty ballast wagons are placed.

The progress made is shown in the accompanying table :—

Description.	Work done during first six years	Work done during [illegible] years.
Dock excavation and loading	491,000 tons	1,010,156 tons
Breakwater filling ...	91,000 tons 200 ft. of length	[illegible] tons 1,200 ft. of length
Quay filling.	304,000 tons	[illegible] tons
Railway filling .	none	17,[illegible] tons
Concrete blockmaking	2,100 blocks	3,665 blocks
Building quay wall and boat quay ...	804 blocks wholly on boat quay	1,[illegible] blocks wholly on quay wall
Ballast crushing	6,000 tons	[illegible] tons
Dredging .. .	10,300 yards	[illegible] yards

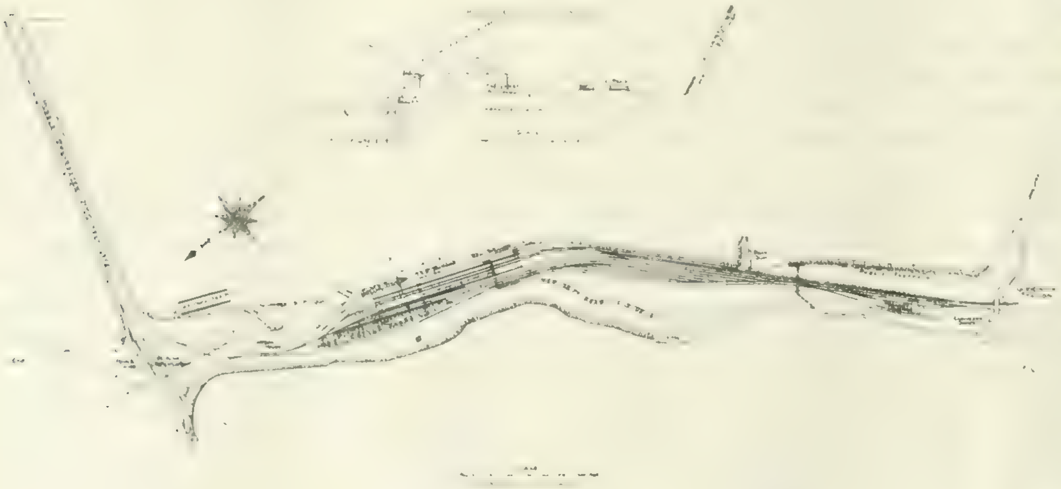


FIG. 1. RAILWAY AND HARBOUR WORKS AT FISHGUARD.

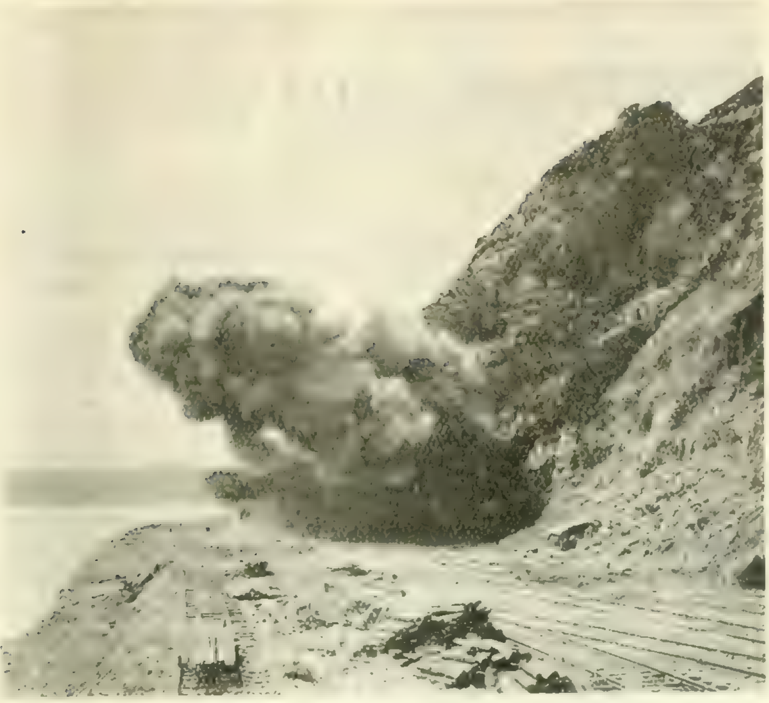


FIG. 3. FISHGUARD HARBOUR WORKS. EXPLOSION OF A MINE.

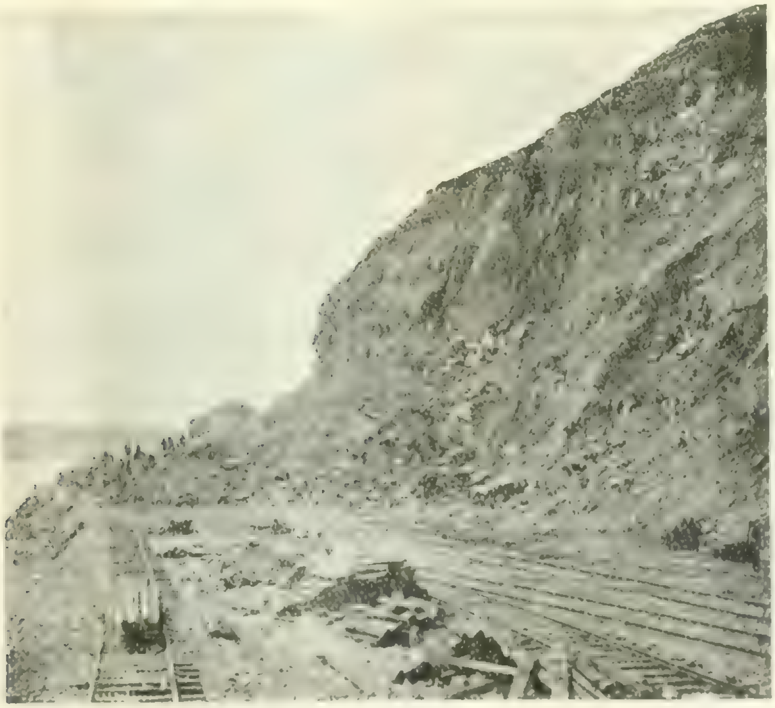


FIG. 4. AFTER THE EXPLOSION.

[illegible] twenty minutes, the rock not being "hand" handled from the time it is placed in the wagons at the quarry.

The quay wall will provide berths for three large modern vessels, the minimum depth of water at these berths and over the rest of the harbour where the boats will turn being 20 ft. Along the quay wall will be nine movable electric cranes, capable of dealing with loads up to 30 cwt. A 21-ton electric crane is provided at the northern end of the quay which will deal with heavy loads and also lift coal wagons and tip them into barges for the supply of bunker coal to the steamers.

PROPOSED FLOATING DOCK

A floating or "pontoon" dock [illegible] ft. long of the "Bermuda" type, capable of lifting a vessel weighing 3,000 tons out of the water in two hours, will probably be erected in the angle formed by the breakwater and the land, which will give very greatly improved facilities for the repair of vessels to those at present existing at Milford. The breakwater [illegible] has a rubble mound surmounted by a parapet, the height of which is to be 20 ft. above high water, and will be about 2,000 ft. long. It will completely shelter 75 acres of water [illegible] deep at low tide from the [illegible] seas that can come into the [illegible]

SHIPBUILDING NOTES.

ON Saturday last the steel-screw steamer *Sir John Jackson*, built by the Northumberland Shipping Company, Ltd., of Howdon-on-Tyne, for Mr. H. W. Dillon, of London, left the Tyne for her trial trip. The steamer is 372 ft. long by 48 ft. beam by 30 ft. 10 in. diameter, and has been built under special survey to the highest class at Lloyd's spar deck rule, with extra strengthening for special freeboard. She is fitted with long poop, long bridge, top gallant forecastle, the accommodation which is very ample being all placed in steel houses on the bridge deck. The 'tween decks are lofty and so arranged that cattle, troops or emigrants may be carried if necessary. Very special attention has been paid to the loading and discharging gear. She is, of course, fitted with the usual water-ballast arrangements for light passages, and will carry about 7,150 tons deadweight loaded. The vessel has been constructed to a fine model with a view to rapid speed and economy in fuel, and the machinery has been supplied by Messrs. Richardsons, Westgarth and Co., Ltd., Sunderland, consisting of engines with cylinders 25 in., 41 in. and 69 in., by 48 in., three large steel boilers 14 ft. by 10 ft. 9 in., 180 lb. pressure. During the trial the engines worked smoothly and satisfactorily, a mean speed of 12 knots being easily attained.

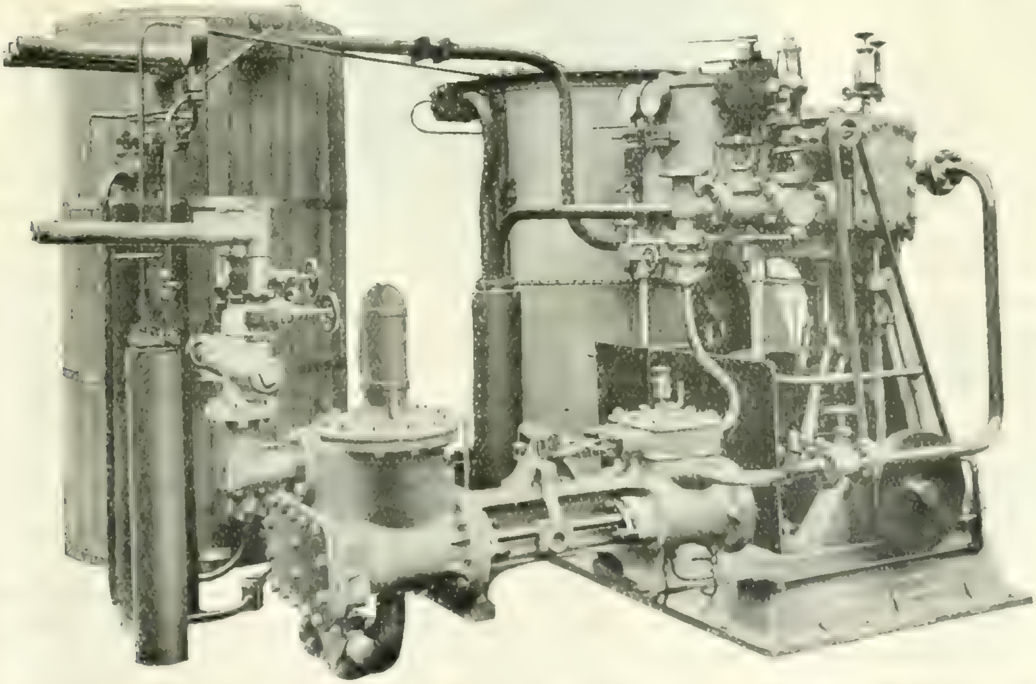
The s.s. *Amerika*, built by Messrs. Harland and Wolff, Belfast, for the Hamburg-American line, left Belfast for Hamburg *via* Southampton, on Thursday morning, the 21st instant. The ship has a gross tonnage of 22,724 tons, and a displacement of between 40,000 and 50,000 tons at load draft. The first-class dining saloon is situated on the main deck, and seats nearly 400 persons. The ship is fitted with passenger lifts, running to the first class saloon, these lifts being driven electrically. There is an inquiry office on the upper deck in front of the grand staircase, connected by telephone with all parts of the ship. The grand staircase leads from the lower to the boat deck, and the balustrade, etc., is formed of iron artistically fashioned, with "gold" handrail, similar to that in the Carlton Hotel, London. There is a nursery for children situated on the upper deck. The principal feature in the ship, however, is the Ritz-Carlton Restaurant on the upper promenade deck, with seating accommodation for about 125. The gymnasium—a speciality in the German ships—is very complete in the *Amerika*. It is at the after end of the lower promenade deck, and is fitted up with complete outfit of Zander apparatus, consisting of twelve machines, seven of which are electrically driven. The vessel also carries a massage attendant, who has charge of the electric light bath, which is situated in a special room on the upper deck, where 30 amperes of electric current act in the form of light on the bather's skin. On the upper deck there is a bookstall, and also a florist's shop. The Marconi house is built of specially large size on the boat deck, with accommodation for two operators, and it will have been observed that between the main and mizzen masts a double Marconi apparatus is arranged.

The ship has also been fitted with a submarine signal apparatus, which allows communication through the water at a distance of seven miles, whereby in fog the ship can be signalled from lighthouses or dangerous points on the coats. The ventilation of the ship is both natural and mechanical, and a large number of electric fans are introduced through the entire vessel. The Imperial suite rooms, situated on the lower promenade deck, are of the most elaborate description, and aft of these in the same deckhouse, on either side, are arranged the "Court" suites or cabins *de luxe*. The ship is fitted throughout with telephones, and in many of the principal staterooms on the upper and promenade decks the passengers will be able to communicate with the stewards, the inquiry office, purser, doctor, etc., without leaving their rooms. The arrangements for both first and second class passengers have been admirably thought out, and for the latter a very fine saloon, ladies' room, and smoking room, have been provided.

The s.s. *Agberi*, which is the latest addition to the fleet of Messrs. Elder, Dempster and Co., of Liverpool, has been built and engined by Messrs. Workman, Clark and Co., Ltd., of Belfast. She left on Friday morning for a trial cruise in Belfast Lough, after which she proceeded to Liverpool, and will be placed shortly on the West African Coast service. The *Agberi* is a sister vessel to the *Patani*, which left the port about six weeks ago, and is 384 ft. long, with a gross tonnage of over 3,400. The cargo holds, four in number, are capable of receiving large and bulky consignments, being practically free from obstruction. Each hold is fitted with a large hatch, and is furnished with the necessary winches and derricks suitable for rapid handling of cargo. The propelling machinery consists of a set of triple-expansion engines, having all the necessary auxiliaries and supplied with steam by three steel multitubular boilers working under Howden's system of forced draught. The *Agberi* has been built in accordance with British Corporation requirements for their highest class, and during construction has been under the supervision of Captain Thompson (Marine Superintendent), and Mr. Wilkie (Engineer Superintendent) for the owners.

The plant, illustrated herewith represents the latest type of refrigerating plant for ships' use, designed by the Pulsometer Engineering Company, Ltd. It is worked on the ammonia compression system. It primarily cools the brine in the refrigerator which is placed in the engine room. The cold brine is then circulated through the cold rooms (viz.: the meat room and the vegetable room), and also through the coils in an ice-making tank, which is generally placed in the vegetable room. This arrangement has been adopted so that no ammonia can escape by any possible means into the cold room.

The piping in the cold rooms consists of galvanised coils placed as close together as possible, through which the brine passes and is circulated by means of a horizontal duplex pump shown in the illustration On the discharge side of this pump will be noticed three regulating valves for regulating the flow of brine to, and to control the temperature of, the meat room, the vegetable room, and the ice box. The ice box is fitted with galvanised moulds, and is capable of holding 5 cwt. of ice. It will be seen that the engine and compressor are of the vertical type and are mounted on one base-plate, making the plant entirely self-contained. The compressor is of the single-acting type as this renders the plant much easier to handle and less liable to leakage. In the illustration can be seen the ammonia condenser and also the refrigerator, the latter being well lagged to prevent loss by radiation. The coils, tank, refrigerator, and condenser are all galvanised, also the brine pipes. The ammonia fittings and valves are of forged steel pattern, cut from the solid. A special arrangement is provided whereby the ammonia can be purified and all oil, etc., extracted from the machine. One of the firm's vertical duplex pumps is used for circulating the water and is placed in the engine room.



REFRIGERATING PLANT FOR SHIPS' USE, BY THE PULSOMETER ENGINEERING CO., LTD.

OUR WEEKLY BIOGRAPHY.

CHARLES HESTERMAN MERZ, M.Inst.C.E., M.I.E.E,

MR. CHARLES HESTERMAN MERZ is the son of Dr. J. T. Merz, Ph.D., of Newcastle-on-Tyne, author of "The History of European Thought in the Nineteenth Century." On the maternal side he is related to the Richardson family, well known upon the north-east coast. Born at Newcastle-on-Tyne in 1874, he was educated privately and at the Durham College of Science, afterwards serving as a pupil with Messrs. Robey, of Lincoln. On leaving this firm he was employed by the contractors at the Bankside Station of the City of London Electric Lighting Company, which appointment he relinquished in order to become resident engineer at the Croydon Electricity Works.

CHARLES HESTERMAN MERZ, M.INST.C.E., M I.E.E.

On completing the Croydon Works he laid down and organised the electric tramways and lighting system of Cork, being soon afterwards appointed consulting engineer to the Walker and Wallsend Union Gas Company, in connection with their power scheme of 1899. Mr. Merz gave evidence before the Parliamentary Select Committee on Power Bills, in 1900. He has thus been connected from the first with the pioneer scheme for electric power supply in this country, and has been responsible from its outset for the design and management of the undertaking, which has now become the Tyneside Power Scheme.

Mr. Merz acts as electrical adviser to the North-Eastern Railway Company, and has carried out for them the electrification of their suburban lines in the Newcastle district, which, together with the Southport line of the Lancashire and Yorkshire Company, forms the earliest example of main line railway electrification in England.

He has been closely connected with the development of electric power supply in engineering works, being consulting engineer to a number of the largest works in the north of England, including those of Sir W. G. Armstrong Whitworth and Company at Elswick, Messrs. Swan, Hunter and Wigham Richardson, etc. He acts as adviser to the County of Durham Electric Power Company, the Cork Electric Tramways and Lighting Company, the Tyneside Tramways and Tramroads Company, the Chatham and District Light Railways Company, the Priestman Power Company, the Lanarkshire Tramways Company, and a number of other schemes.

In addition to these enterprises in various parts of the kingdom, Mr. Merz has for many years made a special study of the problem of electricity supply in London. He is closely connected with the Electric Power Development Company, which during the past Session of Parliament promoted the Administrative County of London and District Electric Power Bill, which failed to become law through the efflux of time. His firm was responsible for the whole of the data on which this proposal was based. It is well known that the object of this Bill was to do for London, its manufacturing districts especially, what has already been successfully done upon Tyneside, where electricity with its many advantages has been almost entirely substituted for steam driving in the factories. Mr. Merz has contributed several papers to learned societies, including an important one on "Power Station Design," read before the Institution of Electrical Engineers on April 28th, 1904, and also one on the "Electrification of the North-Eastern Railway" before the British Association at their meeting at Cambridge in 1904.

Mr. Merz is a member of the Council of the Institution of Electrical Engineers, a member of the Institution of Civil Engineers, the American Institution of Electrical Engineers, the parliamentary committee of the London Chamber of Commerce, and a member of other engineering and scientific societies.

CORRESPONDENCE.

To the Editor of Page's Weekly.

Sir,—As I see you invite [illegible] of remarks on the metrical question in relation to the example you give, I should like to submit the following observations:—

This method of taking as a test case a sample of some special trade standard is a fallacy, and is just where people are apt to go wrong in considering a new method. Parodying Mr. Chamberlain's advice, I would say you must "think metrically." This cannot be arrived at in twenty-four hours, but having seen the change effected in this country I am convinced it could be brought about in England with greater ease. Thirty years ago here all monies and measures were in a state of hopeless confusion, and as difficult to understand as are our own. The Government made the legal standard metrical, and from that day everything official was changed to the new system. Duties were collected by it, statistics published in it, land officially measured by it, etc., etc. At first there was some confusion, but as it was taught exclusively in all schools the next generation never knew any other basis and now everybody uses it as if it were the only standard in existence.

If the British Government were to set the example by adopting it for all official purposes, it would soon become universal without making it obligatory. The money question was solved years ago by Anthony Trollope in "Phineas Finn," where Mr. Palliser, the Chancellor of the Exchequer, proposed to make fifty farthings or ten pence to the shilling, thus making the equivalents 1 shilling [illegible], 1 penny [illegible]; and a farthing [illegible]. What can be easier?

Directly you had the system officially you would have people publishing tables in the various trades of the equivalents. In the case you state "60's" would be equal to some other figure, which multiplied by the linear dimensions and unit price, would give the cost, probably much quicker than by the present method. The only similar case I have a practical acquaintance with is the assay of silver in lead, which in England is stated in ounces troy per ton avoirdupois. You take a certain weight of lead of some multiple of ten, whether grains or grammes matters not, and you get the weight of the resulting button of silver in the same unit or decimal fraction of it. This at once gives you kilogrammes per metrical ton or grammes per kilogramme, but if you want to get it to our standard entails a fairly complicated operation. Fortunately the result can be, and is, obtained by multiplying the decimal fraction by a constant, which at once gives ounces per ton.

The great thing is not to translate, but to think directly in the standard measure. If, for example, "60's" were equal to [illegible] grammes per [illegible] such a yarn would soon be known as "150," and the imaginary difficulty would disappear.

I repeat let the Government [illegible] in ten years there will be very few people who have not fallen into line. In ordering things from abroad using metrical dimensions or weights English manufacturers [illegible] for that reason. Let the Government when asking for tenders for [illegible] the rest will follow.

Yours faithfully,

[illegible]

Aguilas, Spain.

MILLING MACHINE WITH SWIVELLING SPINDLE FROM VERTICAL TO HORIZONTAL.

BY GREENWOOD AND BATLEY, LTD., LEEDS.

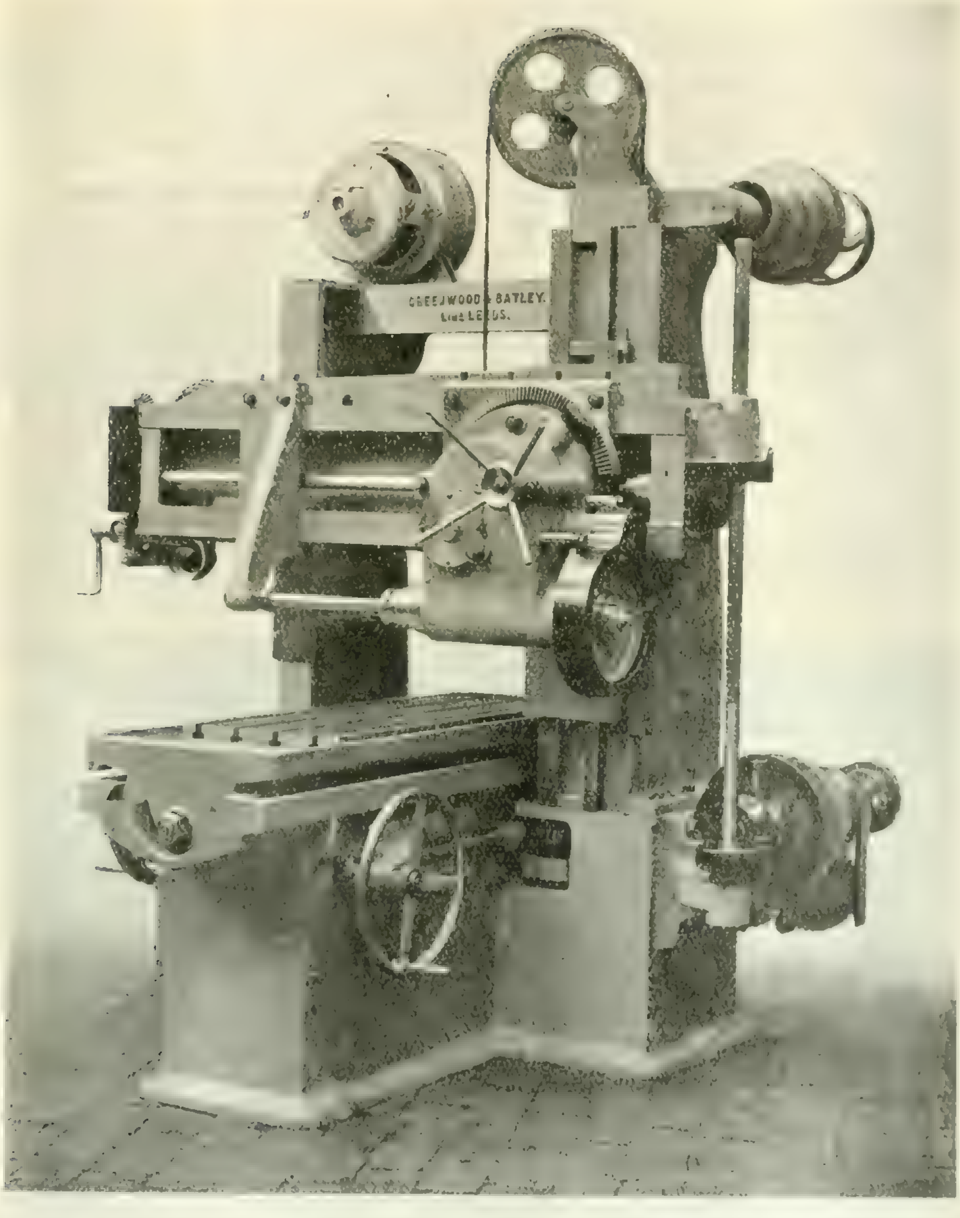
BY the courtesy of Messrs. Greenwood and Batley, Ltd., of Leeds, we illustrate on the opposite page a new electrically-driven milling machine, the chief distinguishing feature of which is that the cutter spindle is mounted in a swivelling head and can be readily set in a vertical or horizontal position, or at any angle between the vertical and horizontal. The spindle headstock is mounted upon a cross-slide and has a self-acting variable feed motion in both directions.

The cross slide is counterbalanced and is mounted upon the main upright; it may be raised or lowered by a vertical screw, geared by means of worm wheel and worm to the hand wheel on the left of the upright stay. The table has a variable feed in both directions, with automatic stop, also quick hand traverse.

The motor is reversible and runs at a constant speed of 1,200 per minute. The machine is belt-driven, the countershaft having a four speed cone, which drives down to the double geared headstock, and this, by means of vertical and horizontal shafts and gear, conveys the motion to the cutter spindle.

The principal dimensions of the machine are as follows: Diameter of spindle, 3 in; revolutions of spindle per minute, 13 to 169; greatest distance from surface of table to centre of spindle—horizontal, 18 in.; greatest distance from surface of table to spindle nose—vertical, 20 in.; cross traverse of spindle (when vertical) on cross-slide, 24 in.; size of table surface, 1 ft. 3 in. by 4 ft.; total length of cable—including troughs, 6 ft. 3 in.; traverse of table, 4 ft. 6 in.; distance between main upright and stay, 2 ft. 6 in.; rates of feed of table per minute, 0·7 in. to 20·6 in.; approximate net weight, 105 cwt.; approximate gross weight, 115 cwt.

THE SWEDISH TORPEDO-BOAT DESTROYER "MAGNI," BUILT BY MESSRS. JOHN I. THORNYCROFT AND CO., LTD.



NEW MILLING MACHINE, WITH SWIVELLING SPINDLE FROM VERTICAL TO HORIZONTAL,

BY GREENWOOD AND BATLEY, LTD., LEEDS.

FLYWHEEL EXPLOSIONS.

By W. H. BOEHME, M.E.

THE writer noticed during the past year no fewer than sixty newspaper accounts of serious flywheel explosions. Of these eighteen occurred during the past two months.

As comparatively few accidents of this kind are reported in the daily press and only a part of the published reports come under my notice, it is safe to say that flywheel disruptions are occurring at the rate of at least twelve per month.

From the nature of the conditions involved, these explosions occur with great violence. Cast iron being a comparatively brittle material, any breakage of a wheel is almost certain to be accompanied by complete disruption. And since disruption nearly always takes place at a rim speed of 3 to 3½ miles per minute, the heavy fragments are hurled with a speed so terrific that everything in their path is mowed down as by a bombardment from heavy ordnance. A single accident often involves the death and injury of scores of employees and a property loss of thousands of dollars.

As an example in point, I may cite the accident that occurred a year ago at the Cambria Steel Company, Johnstown, Pa. In this instance the breaking of a governor belt allowed an engine to run away and burst its 30-ft. flywheel by centrifugal force.

The flying missiles of heavy cast iron wrecked the building and flooded it with scalding steam and water from broken pipes. One man was instantly killed, three more fatally injured, and five others seriously hurt. The building was set on fire.

Another and more recent illustration is the accident that occurred January 3rd this year, at the National Tube Works, McKeesport, Pa. In this instance the bursting of a heavy flywheel killed one man outright, seriously injured three others, and caused damages estimated at $100,000. This estimate included the indirect loss of wages and mill output resulting from the shut-down, as well as the direct loss due to damaged machinery and building.

It will be seen that the frequency and disastrous results of these accidents is really alarming, and that insuring against loss due to flywheel explosions is much the same as insuring against loss due to boiler explosions.

Engine flywheels may be divided into two general classes, those that serve as a flywheel only and those that serve as a combined flywheel and belt wheel. As flywheel, the combined wheel serves to prevent sudden fluctuations of speed due to variations in the load on the engine, and to variations in the crank effort. As belt wheel, it serves to transmit the power developed by the engine.

EFFECT OF HIGH SPEED

High speed is greatly desirable for either of these purposes. High speed means that narrow belts may be used, because the capacity of a belt to transmit power is proportional to its width and to its speed. If the speed of a belt be doubled, for example, it need be only one-half as wide to transmit the same amount of power. High speed also means lighter wheels, because a narrower-faced wheel will serve to carry the narrower belt required.

In the case of an overloaded engine, more power may be obtained by increasing the speed, because the power developed by an engine increases directly with its speed. If the speed be doubled, for example, the power will be doubled, and this without any increase in the steam pressure. If the engine and wheel will stand the increase in speed, this will give also the advantage of better speed regulation.

The capacity of a flywheel to prevent sudden fluctuations of speed is proportional to the weight of the wheel and to the square of its speed. If the speed can be doubled, for example, only one-fourth the weight will be required to give equally efficient speed regulation.

It will be understood from the foregoing that even a slight increase in speed means a considerable saving in the weight and cost of the wheel and in the cost of the belting; and in the case of an overloaded engine it may mean saving the cost of a larger engine to develop the power required. The temptation to run flywheels at high speed is therefore great, so great in fact that they are often run at a speed dangerously near the limit of safety.

Wheels that serve only as flywheels have narrow, thick rims, often of approximately square cross-section. Those that serve as combined flywheel and belt wheel have thin rims, wide enough to carry the belt used to transmit the power developed by the engine.

PRIMARY CAUSES OF EXPLOSION

Such wheels may fail primarily from two causes, namely, from overload or from overspeed.

Overload may be produced in a number of ways, among which may be enumerated:—

(*a*) Clogging of the machinery in the mill.

(*b*) An unusual number of machines may be forced at the same time.

(*c*) Careless or ignorant handling of friction clutches.

(*d*) If the engine drives electrical machinery, the overload may be produced by a short circuit.

(*e*) Sudden stoppage of the engine, as when the piston comes off and blocks the piston rod.

In many instances the overload is produced suddenly and causes the wheel to fail either by the torsional strain produced, or by the crushing strain due to the pressure of the belt acting against the rim.

Overspeed causes the wheels to explode by centrifugal force. By overspeed I do not especially refer to high normal speed, although many wheels are run normally at dangerous speed. What is particularly referred to is the accidental increase in speed beyond that for which the governor of the engine is set, and which is commonly called "racing." Racing may be produced by:—

(*f*) Governor being improperly designed.

(*g*) Slipping or breaking of governor belt or of governor pulley.

(*h*) Derangement of governor by internal or external causes, as when a stem or a rod gets stuck, or a ball gets broken off.

(*i*) Derangement of valve gear.

(*j*) Safety stops improperly set, or governor blocked.

(*k*) Sudden reduction of load, as when the main driving belt breaks or an armature burns out.

CONTRIBUTORY CAUSES.

Besides the primary causes enumerated above, there may be mentioned as contributory causes:—

(*l*) Defects in the design, material or construction of the wheel.

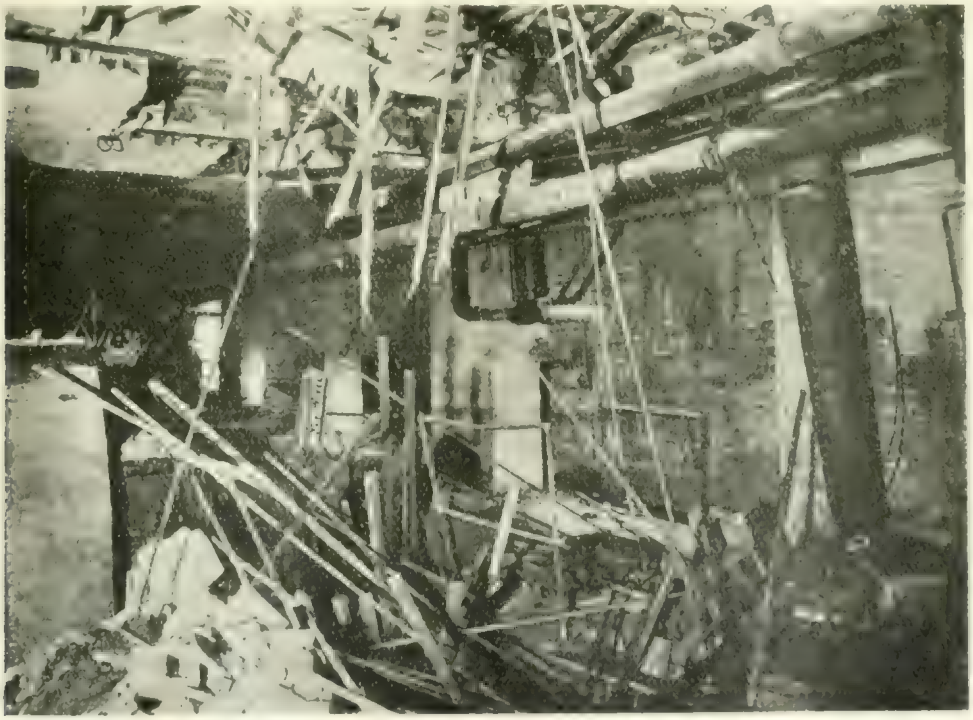
(*m*) Failure of some part of the engine, as when its bed breaks or its shaft fails, and throws the wheel against the side of the wheel pit.

(*n*) An idler pulley or a driving pulley may break first and derange the governor or valve gear by hurling fragments into them.

In the case of a condensing engine, racing often continues until the wheel is disrupted, even after the engineer has succeeded in shutting off the steam.

(*To be continued.*)

From a paper contributed to Insurance Engineering.



FLYWHEEL EXPLOSION, ELECTRIC POWER PLANT, CLEVELAND, OHIO.

NAVAL NOTES.

THE Swedish t.b.d. *Magne*, shown on page 704, was constructed at the works of Messrs. John I. Thornycroft and Co., Ltd. On the 31st ultimo, she completed her full speed trials over the Maplin measured mile in the estuary of the Thames. During the three hours' trial with a load of fifty tons a mean speed of 30·705 knots was obtained, the contract speed being 30·5 knots, while the number of revolutions were 398 per minute. Steam was easily maintained during the run, the mean horse-power being 7,70c. The boat was remarkably free from flaming at the funnel while the steadiness of the gun platform at full speed compared favourably with the 25-knot river type of the British destroyers. At the conclusion of the trial the two sets of four-cylinder vertical-triple compound condensing engines were opened out, thorough examination showing them to be in excellent condition. The four boilers, which are of the Thornycroft-Schulz type, were also inspected and found to be in good order.

The *Magne*, as readers of PAGE'S WEEKLY are aware, is a sister ship to the Japanese destroyers *Shirakumo* and *Asashio*, which proved so successful in the recent Russo-Japanese war; these boats were in commission during the whole of the war and proved themselves seaworthy in a very practical manner, during the operations before Port Arthur in heavy weather.

In connection with the *Magne* it is interesting to note that in 1872 the same firm designed and built for the Swedish Government their first torpedo-boat, this being the second one of its kind in existence at the time. The first one was built by Messrs. Thornycroft for the Norwegian Government. The following is a comparison between the Swedish gunboat and the *Magne*:—

	1872 Gunboat.	Magne.
Length ..	58 ft.	219 ft. 9 in.
Beam .	7 ft. [illegible] in.	20 ft. 9 in.
Engines ..	Compound steam engine; cylinders, 7 in. and 11 in. by 8 in.	Two sets of four-cylinder vertical triple – expansion condensing engines, i.h.p., 7,700.
Speed ..	17 knots.	30·705 knots.
Armament	Two outrigger spar torpedoes.	Two revolving torpedo tubes for self-propelling torpedoes, six 57 m.m. quick-firing guns.

The United States battleship *Vermont*, recently launched from the yard of the Fore River Shipbuilding Company, will be one of the largest and most powerful units of the American navy. She has a length of 450 ft., and will carry the following armament: Main battery, four 12-in. breech-loading rifles; eight 8-in. breech-loading rifles; twelve 7-in. breech-loading rifles. Secondary battery: Twenty 3-in. 14-pounder, rapid-fire guns; twelve 3-pounder and semi-automatic guns; six 1-pounder automatic guns; two 1-pounder semi-automatic guns; two 3-in. field pieces; two machine guns, calibre ·30; six automatic guns, calibre ·30. The hull is protected at the water line by a complete belt of armour 9 ft. 3 in. wide, having a maximum thickness of 11 in. for about 200 ft. amidship. Forward and aft of this the maximum thickness is gradually decreased to 4 in. at the stem and stern. The lower casemate 6 in. armour extends to the limits of the magazine spaces and reaches from the top of the water line belt to the lower edge of the 7-in. gun ports on the main deck.

IRON AND STEEL INSTITUTE MEETING.

VISIT TO THE EAST HECLA WORKS.

(Continued from page 6[illegible].)

SHRAPNEL SHOP.

AMONG the exhibits were 13 and 18 Qr. F. forged steel shrapnel shells, in various stages of manufacture, and it was ascertained that Hadfield's have in course of execution very large orders for 18 lb. Shrapnel shells for the New British Field Artillery. These shells have to be supplied of a special quality steel having a very high tenacity so as to avoid setting or breaking up in the gun.

FIRING DEMONSTRATION.

The interesting demonstration at their firing butt showed the increased penetrating effect of capped projectiles against modern hard faced steel armour as compared with the uncapped variety. Two 10·5 c.m. (4½ in.) diameter shell were fired from a Krupp gun at a hard faced armour plate 4 in. in thickness, striking the plate with a velocity of 1,920 foot seconds. The first shell in the uncapped condition was completely shattered, the plate remaining unperforated, but the second, a capped "Heclon" shell, went through the plate, backing, and into the sand, but, being recovered unbroken and in a fit condition for bursting.

In one of the shops was shown "Heclon" shell from 4 in. to 12 in. calibres, which had perforated unbroken a calibre each respectively of the latest type of Krupp hard-faced armour.

THE FOUNDRY.

The steel foundry is probably the largest in the world, being 1,050 ft. long, and covering six acres. There are about 40 overhead electric, and 13 electric jib cranes. The visitors were shown moulding of all classes of castings in various stages of production.

ANNEALING SHOPS.

These shops are in three séparate buildings, and cover an area of 50,000 square feet. There are numerous annealing furnaces, with overhead electric cranes. The heat treatment of steel, which is carried on in connection with the annealing department, is an important part of the Hadfield system.

POWER STATION.

The central power station for supplying electric current for power purposes, and for electric lighting, is equipped with five units, in all of a total horse-power of about 3,000. The dynamos are all driven by cross-compound Corliss engines. The engines all exhaust into a central condensing plant, water from the river Don being used. Motors ranging from half-horse-power up to 150 h.p., are supplied with current from this station.

PATTERN SHOP.

All tools are electrically driven. The building is well lighted, and covers an area of 96,000 square feet on one floor. The wood working machinery is of the most modern description. The patterns for the castings of a large junction for the London County Council's system of electric tramways were shown to the visitors, and served to illustrate the extremely difficult nature of this class of work from a steel founder's point of view.

MACHINE SHOPS.

These are all of large size, covering an area of four to five acres. They are fitted with a large number of machine tools of the most powerful description, and of modern type. All the machines are electrically driven in accordance with the best modern practice, and to facilitate the handling of materials, overhead electric travellers are employed. The buildings are 435 ft. long, and there are ten bays in all.

In these shops were to be seen groups [illegible] machined steel castings and forgings of [illegible] every conceivable description, from a few pounds in weight to 25 tons each, including bridge castings for the River Wear new bridge, which is being constructed by the North-Eastern Railway, locomotive wheel centres, railway wagon wheels and axles, wagon wheel centres, also carriage and wagon castings for the principal British and Colonial railway companies. Cast steel hydraulic cylinders, rams, and glands, machined and ready for use. Cast steel cylinders are supplied by Hadfield's up to 27 ft. long, either as castings or machined and finished; dredger tumblers, pins, links, and bushes all made of Hadfield's patent "Era" steel; Hadfield's special steel tyred wheels and axles for electric tramcars, magnet rings, motor cases, and all kinds of castings for electrical engineering, gear wheels, etc., etc.

Within the past few years, as our readers are doubtless aware, the Hadfield Company has entered very extensively upon the construction of rock and ore crushing machinery, and two bays of the large machine shops are now set apart for this class of work. The Hadfield and Jack's Patent "Heclon" gyratory rock and ore breaker, the firm's patent jaw crusher and other special appliances in this department, were recently described and illustrated in these columns.

COLLIERY TUB CONSTRUCTION DEPARTMENT.

The Colliery tub department shown covers an area of 23,760 square feet.

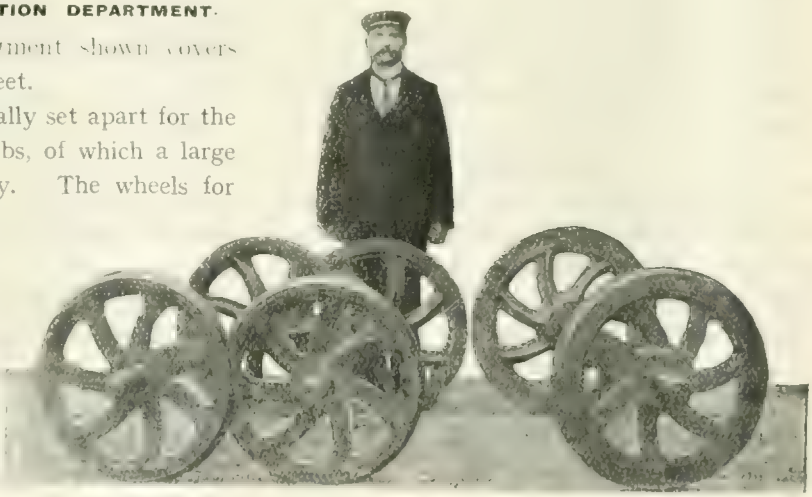
This department is specially set apart for the construction of colliery tubs, of which a large number are made annually. The wheels for the tubs are not fitted in in the ordinary way, but are forced on their axles by hydraulic machinery of a powerful nature. The axle ends are made of such a size in regard to the hole in the wheel that the latter can only be forced on by the exercise of very great pressure. Indeed, the fit is so close that the axle will take shavings off from the inside of the wheel. In this way absolute metal to metal surfaces are secured, and there is no possibility of grease or oil getting in between the inside of the wheel and the axle, thus leading to wheels becoming loose. Another large hydraulic press in this department is used for bending the angle and flat iron of which the tubs are built up.

FORGE AND SMITH'S SHOPS.

The forge and smiths' shops cover an area of 21,150 square feet, and both shops are fitted with the latest appliances. In the Smith's shop there are several large hammers which are solely used for fitting colliery tub wheels on to axles by Hadfield's special fast method.

RESEARCH WORK

The contributions made by Mr. R. A. Hadfield to metallurgy in the field of original research are well known to the readers of PAGE'S WEEKLY. In this connection an exhibition of apparatus for research work, etc., proved by no means the least important part of a highly instructive and enjoyable visit.



STEEL TYRED CAR WHEELS WHICH RAN 79,860 MILES IN 2½ YEARS.

THE IRON AND WIRE ROPE WORKS OF MESSRS. W. COOKE AND CO., LTD., TINSLEY.

On Wednesday a visit was also paid to the iron and wire rope works of Messrs. W. Cooke and Co., Ltd., Tinsley. Profitting by the lessons of the last thirty years this firm has relegated old methods to the limbo of the past, and a most instructive feature proved to be the new wire rod mill which the firm completed in July last year at a cost of over £20,000. The plant was designed by Mr. R. Heber-Radford, M.I.M.E., the company's consulting engineer, and was carried out by Messrs. Marshall, Sons and Co., Gainsborough, who were responsible for the 1,200 h.p. engines. Furnished by the Brightside Foundry Company, Sheffield, the mill is designed for rolling high-class rods only for rope wire, card wire, etc. The billets are heated in a new form of Siemens' gas furnace. From a spectacular point of view the operations of rod rolling and wire-drawing are warm, but well worth witnessing. To quote the picturesque description of a Sheffield Daily Telegraph correspondent: "when the billets of red-hot mat metal are rolled into rods of sufficient length, they are put through the mill, and are drawn through a series of orifices in glowing loops of red-hot metal. As the end of the wire emerges on the one side of the mill, it is immediately seized by a pair of clippers, handled by a workman, and whipped round into the next orifice. So the process goes on until the wire is reduced to the required diameter. It finally emerges almost as thin as a whip, and then, still in its red-hot state, it is passed on to the coiling machine. Long after the coils have been made up they throw off tremendous heat, making standing in close proximity to them a trying matter. The new mill is not built on any of the American principles, but in some particulars is new in design."

The wire rope factory of Messrs. Cooke's establishment was erected in 1887, enlarged in 1897, again in 1902, and an additional 16,000 square feet has lately been added, making in all 40,000 square feet of flooring for machines. It is equipped with the most modern wire rope machinery for dealing with all kinds of rope, as used by mines, ships, and engineering works.

On Wednesday evening members were invited to dinner at the Cutler's Hall by the Reception Committee, and thereafter an adjournment was made to the Lyceum Theatre, where a new musical play filled the bill.

THURSDAY.

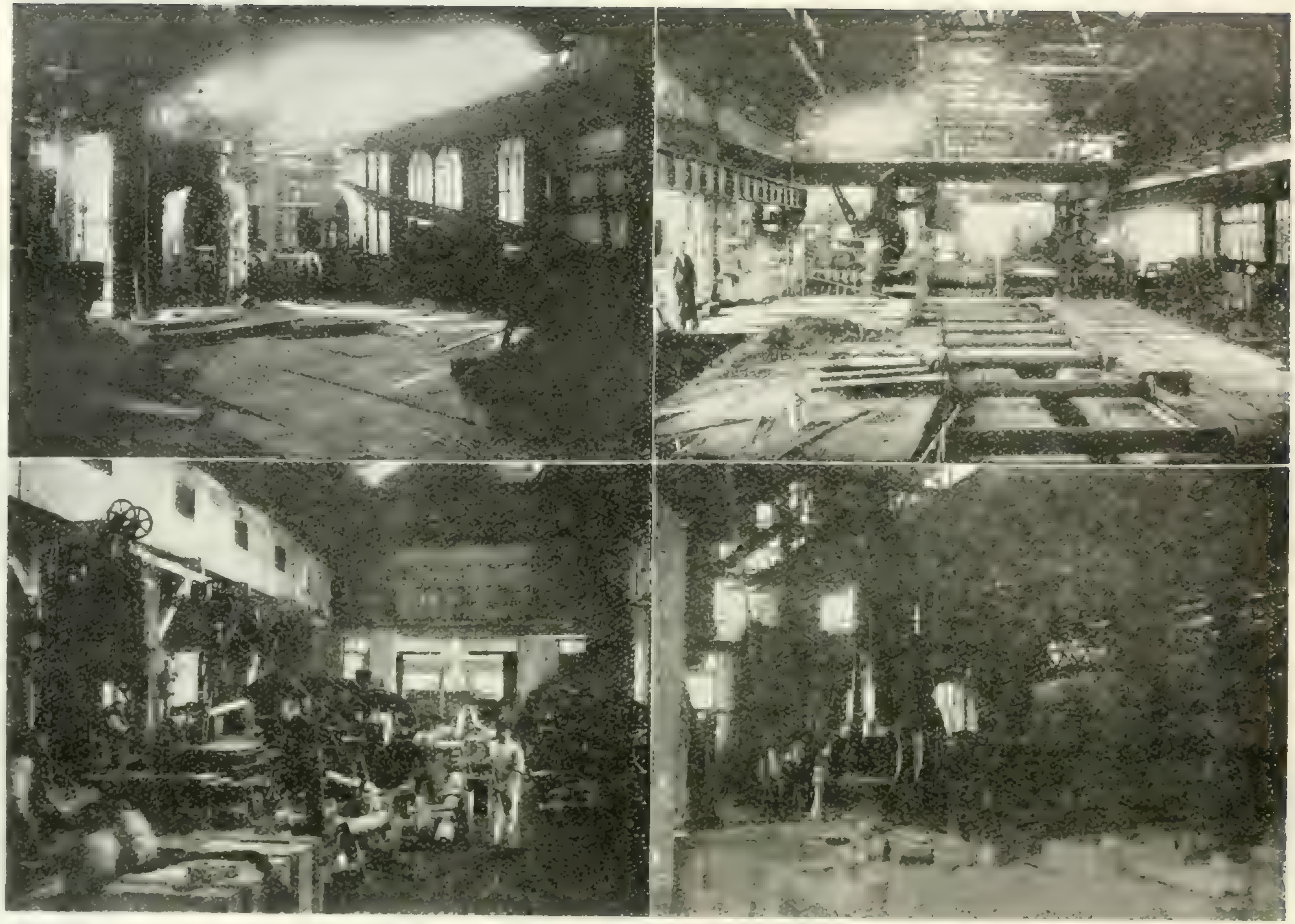
Yesterday the members of the Institute devoted themselves entirely to visiting works, including the Norfolk Works of Messrs. Thomas Firth and Sons, the Atlas Works of Messrs. John Brown and Co., Ltd., the works of the Parkgate Iron and Steel Company, Ltd., near Rotherham, the Grimesthorpe Works of Messrs. Cammell, Laird and Co., Ltd., the River Don Works of Messrs. Vickers, Sons and Maxim, Ltd., the Ickles Works of Messrs. Steel, Peech and Tozer, Ltd., etc., etc. Owing to pressure upon our space details of these visits are held over until the next issue. In the evening there was a reception at the Cutler's Hall by invitation of the president and Mrs. R. A. Hadfield.

FRIDAY.

To-day is being devoted by some of the members to Welbeck and the Dukeries, while others are exploring Chatsworth, Rowsley and Haddon Hall. The meeting winds up in the evening in a good old-fashioned way with a display of fireworks.

BENNETT H. BROUGH, F.G.S., ASSOC.R.S.M., F.I.C.,

To whose [illegible] [illegible] much of the success of the [illegible] meeting of the Iron and Steel Institute is due.



VIEWS AT THE ICKLES WORKS OF MESSRS. STEEL, PEECH AND TOZER, LTD., VISITED ON THURSDAY BY THE IRON AND STEEL INSTITUTE.

Cogging Mill.
Machine Shop

Rail Billet and Axle Mill
7-ton Hammer.

MEETING OF THE IRON AND STEEL INSTITUTE.

(Continued.)

THE PAPERS.

THE DEPARTMENT OF IRON AND STEEL METALLURGY AT THE UNIVERSITY OF SHEFFIELD.

By John Oliver Arnold,

Professor of Metallurgy in the University of Sheffield.

BEFORE describing the laboratory itself, Professor Arnold gives a brief account of the laboratories to which it is supplementary. Details of these will be found in another connection on page 681. The professor incidentally remarks that the metallurgical department of the University of Sheffield is unique in placing its evening students on the same footing as day students; and it is interesting to note that out of 39 graduates who have won the Associateship in Metallurgy (an examination about equivalent in severity to the average University B.Sc. in honours), 20 were day students and 19 evening students. These facts it is considered fully justify a departure of the Senate adversely criticised by many university men.

The main objects borne in mind in designing the chief practical laboratory were the erection on a manufacturing scale of plant producing steel by the three standard methods of manufacture, namely, crucible, Bessemer, and Siemens steels.

The crucible plant consists of a six-pot new form Siemens gas furnace capable of melting 360 lb. of crucible steel at one time. The economy of fuel in this furnace compared with the old coke system is very great, but it has not yet been decisively ascertained that the gas-melted steel is equal in quality to the coke-melted material.

The Siemens furnace is also of new form and is capable of making heats up to 2½ tons. This furnace is also economical owing to the gas retaining the initial heat of the producer, the complete combustion of the tar, and the whole of the regenerative surface being utilised for heating cold air. The ladle is by Messrs. Stevensons, Ltd., of Preston.

The plant made by Messrs. Davy Bros., Ltd., Sheffield, to exemplify the Bessemer process, consists of a 1-ton vessel fitted so as to take a very shallow bottom blown bath, a side blown heat by the Robert modification, or a surface-blown heat by the modification of Tropenas. The reservoir for the blast consists of a 20-in. underground main 65 ft. long. The blowing engines (made by Messrs. Alley and MacLellan of Glasgow) have three cylinders 28 in. in diameter with a 12-in. stroke. They deliver 2,750 cubic feet per minute of uncompressed air, or 2,000 cubic feet per minute, at a pressure of 5 lb. per square inch. The valves are moved positively, the pistons being single acting, and the cylinders water-jacketed. The lubrication is effected under pressure by an oil pump driven off the crank-shaft. This engine is driven by a 115 h.p. two-phase motor.

The cupola which serves both for the converter and ordinary cast-iron foundry work, is fitted with double spark-catchers, and is made by the Whiting Foundry Equipment Company, of Chicago. The main shell is 48 in. in diameter, lined up to about 39 in. This cupola has a drop bottom. The blast is supplied by an improved Roots blower, made by Sir B. Samuelson and Co., Ltd., of Banbury, this blower being driven by a 15 h.p. motor. The blast pressure is regulated by means of water resistance.

In addition to the main equipment there is a hydrocarbon heat treatment muffle, with 15 square feet of floor space, designed by Mr. Clinch-Jones. This is connected with the Uehling recording pyrometer. There is also a 20-foot-ton falling weight apparatus, the mild steel bed-block of which weighs 2½ tons, and was made in the laboratory. There is a smith's shop provided with two drills for drilling spoon samples and ingots. There is also a roomy laboratory for colour carbons. Steel castings and moulds are dried by means of a portable Piftin stove. A notable addition to this laboratory is an electrically-driven pneumatic hammer, by Messrs. W. and J. Player, Ltd., of Birmingham. The weight of this hammer is nominally 7 cwt., but it more nearly approximates half-a-ton, and is driven by the blowing-engine motor. It is capable of dealing with 4 in. ingots and striking 100 blows per minute. There is also a coal fire reheating furnace adjoining.

The motive power throughout is electrical with the exception of a Cochrane boiler which works the injector jets of all the furnaces. The current is two-phase, and is supplied by the City Corporation. The foundry [illegible] ated by a 4 ton three-motor crane by Messrs. T. Smith and Sons, of Rodley. The aggregate horse-power of the motors in this laboratory is [illegible]. The extent of the experimental operations carried out are exemplified by the fact that during the last session over 40 tons of ingots and castings were made, but unless Government financial support is secured, it will be impossible in future sessions to work on so large a scale. In connection with research work it may be mentioned that since 1889 the staff and students of the Metallurgical Department have published about thirty original researches.

THE USE OF VANADIUM.

M. Léon Guillet, D.Sc. (Paris), presented a painstaking paper on the use of vanadium in metallurgy. He traces the history of the metal from its discovery in 1830 by Sefström, in the laboratory of Berzelius, and lays particular stress on the value of the results published by Professor Arnold in 1900, showing as they did, very accurately, the influence of vanadium upon steel—an increase in the tensile strength and elastic limit, without lowering the elongation. The results of his preliminary tests of tools with 3 per cent. of vanadium created a profound impression and indicated the great future which lay before the metal. It was shown that the action of this element resembled tungsten, but that it was twenty to thirty times more powerful. In 1902, Professor Arnold made a fresh series of investigations, the results of which, however, were not published and remain the property of the New Vanadium Alloys Company, Ltd., on whose behalf they were carried out. The author summarises his own researches as already published in the Revue de Metallurgie. Two series of vanadium steels were studied, one containing but little carbon and the other about 0·85 per cent. of this element.

It is in an examination of the quenched steels that the true interest attaching to vanadium steel reveals itself. Vanadium has the characteristic of producing, on quenching pearlitic nickel steels, an extraordinary increase in the tensile strength (when compared with that of a normal steel), and this occurs with elongations which still remain considerable, and a marked non-brittleness. The author does not think that these results have been obtained with any other elements.

In his conclusions the author says: It may be affirmed that in all the cases studied up to the present vanadium considerably improves the mechanical properties of metallurgical products. Its effect may be characterised as follows:—

On normal steels it produces a very distinct increase in the tensile strength and elastic limit, and has no influence, or an insignificant one only, on elongation and contraction, and upon resistance to shock. It slightly increases the hardness.

On quenched steels vanadium considerably increases the tensile strength and elastic limit; it acts in this way, with almost as great an effect, as carbon, yet, notwithstanding this, it does not increase the brittleness. The influence of vanadium in metallurgy is thus of considerable importance. It is undoubtedly the element which, together with carbon, acts with the greatest intensity in the way of improving alloys of iron—that is to say, in very small percentages. It is to be specially noted, however, that alloys of iron, carbon, and vanadium are more sensitive to heat treatment and mechanical handling than ordinary steels, but this does not appear to be any longer the case in more complex alloys, particularly in nickel-vanadium steels.

It remains to consider the influence of the addition of vanadium upon the cost per cent. of the vanadium contained. The cost of production of ferro-vanadium is such as to readily allow of its addition, and if, at the moment of writing, the price of ferro-vanadium is still high (about £1 per lb. of vanadium contained), this must be attributed to the scanty demand, which is altogether inadequate, and consequently entails expenses of manufacture, which are spread over but a very small output, thus considerably increasing the price. This state of affairs will disappear when the use of vanadium becomes more widespread. It may be concluded that the employment of vanadium in the manufacture of special steels is distinctly indicated, particularly in the manufacture of quaternary alloys such as iron-nickel-carbon-vanadium.

It is probable that vanadium will give highly interesting results with copper and its alloys, but no systematic study relating to this has yet been carried out.

In one part of his paper the author says it is affirmed on many sides that vanadium is largely used in the metallurgy of copper and of its alloys. He believes, however, that he can affirm the contrary to be the case; he has never been able to obtain a sample that could be truly described as commercial.

STEELS USED FOR MOTOR-CAR CONSTRUCTION IN FRANCE.

The same author in the course of a further paper gives an account of the special steels used in France for the construction of motor cars in France. These he summarises as follows:—

[illegible] steels with low percentages of carbon and nickel (pearlitic steels) which are used for parts which require cementing and quenching—*i.e.*, shafts, gears which engage directly, etc.

(2) Steels with medium percentages of carbon and low percentages of nickel, used, after quenching and reheating, for a large number of parts, shafts, gearing, pinions, etc.

(3) Steels low in carbon and with high percentages of nickel, used for valves.

(4) Chromium steels, with high carbon and low chromium percentages, used for bearings.

(5) Silicon steels, used for springs and for gearing.

(6) Nickel-chromium steels, with low percentages of nickel and of chromium, employed for numerous parts requiring resistance to shock, and a certain degree of hardness.

A new steel known as NY, the composition of which has not been published.

Many other steels have been investigated, and the author shows why their use has been, in part at least, abandoned. .

Steels with low nickel (1 to 6 per cent.) and very low Carbon (0·10 to 0·25 per cent.).

In his description of these steels the author says :—

These steels are used in place of ordinary case-hardened steels. He indicates the fresh conclusions he has arrived at on case-hardening. In order to avoid all brittleness in the interior and exterior of the piece, and, at the same time, to obtain a high degree of superficial hardness, and a very regular degree of carburisation,* it is necessary—

(1) To use a steel containing less than 0·12 per cent. of carbon, and with a low percentage of manganese (less than 0·30 per cent.), and

(2) To case-harden (with a chemically definite material), such as a mixture of 60 parts of charcoal and 40 parts of barium carbonate) at a temperature between 850 deg. C. and 1,050 deg. C.—the higher the temperature the more rapid the case-hardening—and allow it, after the operation, to cool down just below the transformation point (about 600 deg. C.).

(3) To reheat the piece and quench it at 900 deg. (just above the transformation point of the centre), this operation having the effect of rendering the centre fibrous. After the heating it is coarse grained, but after quenching, the surface is brittle.

(4) To quench for a second time at 800 deg., C. (above the transformation point of the exterior), to render the skin non-brittle. Mr. Le Chatelier had advocated the following treatment, after case-hardening, viz., reheating to 900 deg. C., and quenching at 800 deg. C. ; it will be found that the double quenching, under the conditions outlined above, will lead to a much more noticeable improvement.

In any case, the methods by which it is possible to obtain, with low carbon steel, case-hardened pieces which shall not be brittle, are exceedingly delicate. The author sought, in 1902, to remedy this state of affairs, by employing special steels. With this object a series of very low carbon steels, containing ascending proportions of different elements, such as nickel, chromium, and manganese, were submitted to case-hardening under identical circumstances.

He demonstrated the considerable advantages which nickel steels possess. Manganese and chromium steels present no interest from the point of view of case-hardening. For the nickel steels it was shown, first, that the proportion of nickel must amount to two per cent., to obtain the maximum non-brittleness ; and secondly, by quenching once at 800 deg. C. results can be obtained equal, at least, to those obtained on twice quenching ordinary carbon steel. From an industrial point of view this advantage is considerable, not only because of the saving of time, but particularly from the fact that this double quenching has obviously a much greater warping effect on the pieces than the single quenching. The use of steel with but little carbon and a low percentage of nickel has become general in the motor-car industry. As a rule steels contain from 0·10 to 0·15 per cent. of carbon, and 1·5 to 2·0 per cent. of nickel.

The author points out that starting with a steel containing 7 per cent. of nickel and 0·12 per cent. of carbon, it is possible, by simple case-hardening alone, to obtain the same results as by case-hardening followed by quenching. I will not dwell on the importance of this process which, both in France and elsewhere, is carried out under the license of the Dion-Bouton Company.

By observing the necessary precautions, and, in particular by annealing the steel on its arrival from the mill to destroy hammer-hardening, and by taking care to allow the cemented pieces to cool as slowly as possible, it becomes possible to avoid all the worries which accompany quenching and consequently all the operations which should follow it, *i.e*, straightening and re-adjusting.

It must further be noted that this steel (carbon, 0·12 ; nickel, 7·0 per cent.) possesses certain very interesting mechanical properties in the annealed state, and that these properties are not changed on case-hardening. Its mechanical properties are :—

Tensile Strength.	Elastic Limit.	Elongation.

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* [illegible] apply only to carbon [illegible]

The motor-car parts which are not usually case-hardened are axles, particularly for single-cylinder cars, and crank-shafts in regard to which the serious deformations which occur render it desirable to avoid the operations of case hardening and quenching. The gearing, or at least such of it as is subjected to much work, and, generally speaking, all parts that have to undergo friction, and are not liable to any risk of shock.

The only chrome steels used in the motor-car industry are those employed for bearings. These steels usually contain 1 to 1·2 per cent. of carbon, with 1 to 2·5 per cent. of chromium.

They undergo, before use, the operation of quenching, but it is to be noted, that if they are quenched for a lengthy period in water, these steels display water cracking. On the other hand, quenching in oil does not harden them sufficiently. This disadvantage can be remedied by making them undergo a double quenching, at temperatures of 800 deg. C. and 850 deg. C. respectively, the first in oil and the second in water. Under these conditions water cracking is avoided. The theoretical explanation of this process which in practice gives excellent results, is not clearly understood. The process is, the author believes, employed in the treatment of armour-piercing projectiles.

Silicon steels display extreme brittleness in a direction at right angles to the plane of rolling. They are, furthermore, highly sensative to heat treatment; a variation of only 25 deg. C. in the temperature of annealing induces important variations in their mechanical properties.

Possessing such disadvantages, one may be surprised that these steels should find such general employment for gears; they have nevertheless given good results. Their surface hardness is, after suitable treatment, sufficiently high to prevent the metal from spreading, and, on the other hand, the brittleness may not be very great, especially when starting from hammered samples. The steel is, nevertheless, one which requires exceedingly delicate heat treatment, which will explain the trouble which has been experienced with it at certain works which have been insufficiently furnished with hardening and annealing appliances.

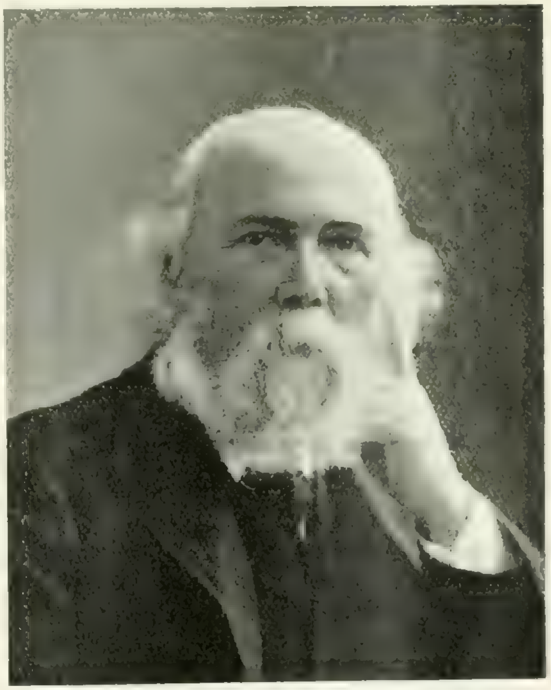
Attempts have been made, particuarly in France, to substitute tungsten for silicon in spring steel. It does not seem to the author that the resulting improvement is very marked; obviously the brittleness across the grain has been diminished, but this is not very important in the case of springs. At the same time the cost of production has been sensibly increased, while the brittleness in the direction of rolling may also have been somewhat accentuated.

Among other ternary steels aluminium steels present no peculiarities which might attract the attention of motor-car builders. Chromium and tungsten steels do not appear likely to find any further application than they do at present. Vanadium steel appears to the author to be full of promise.

Among the quaternary steels discussed, the author mentions a steel quite recently discovered by the Commetry-Four-chambault Company, at the Imphy Works. It is known as mark NY, the composition of which has not been made public, and possesses the following characteristics:—

	Annealed at Cherry Heat, 900° C.	Quenched at [illegible] and not Annealed.
Tensile strength	31¼ tons to 3[illegible] tons	82½ tons to [illegible] tons
Elastic limit .	25½ tons to 28 tons.	73 tons to 79 tons.
Elongation .	30 to 25 per cent.	10 to 8 per cent.

It will thus be seen that this steel presents, before hardening, all the properties of a semi-hard steel; it works similarly. After quenching at 850 deg. C. without reheating, that is to say, after an exceedingly simple treatment—it posseses all the properties, so highly valued, of quenched and reheated silicon steels. It possesses, as compared with the latter, the great advantage of not requiring to be reheated, and, above all, of not possessing the peculiarity of brittleness perpendicularly to the plane of rolling, which is so characteristic of silicon steels.



SIR WILLIAM THOMAS LEWIS, BART.

THE THERMAL TRANSFORMATIONS OF CARBON STEELS.

BY

John Oliver Arnold and Andrew McWilliam.

Respectively Professor and Lecturer in Metallurgy in the University of Sheffield.

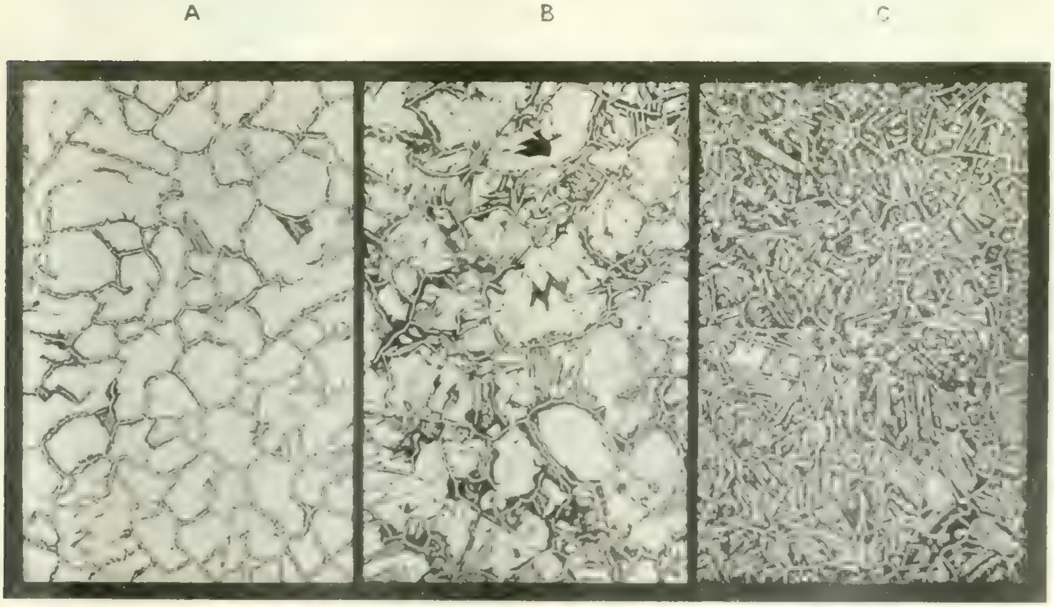
(Summary.)

The cooling transformations of an unsaturated iron and carbon steel previously heated to about 950 deg. C., when studied under suitable thermal conditions on a steel in which the points Ar3 Ar2 and Ar1 can be clearly differentiated, lead to the following conclusions: Above Ar3 (*i.e.*, 810 deg. C.) the ferrite and hardenite are in mutual solution as a homogeneous mass. The Ar3 change is accompanied by a segregation of the two constituents, which, if the cooling be slow, is probably completed in the Beta range of temperature. Hardenite is insoluble in ferrite in both the Beta and Alpha ranges of temperature. It, however, still retains its identity as hardenite whilst falling through, say, 30 deg. or 40 deg. C. of temperature in the Alpha range—namely, from the end of Ar2 at about 720 deg. C. to the beginning of Ar1 at about 680 deg. C., at which latter temperature it begins to decompose into pearlite.

The heating transformations of the above steel are substantially as follows: At Ac 1 (about 710 deg. C.) in the Alpha range the pearlite begins to change into hardenite, hence the B carbide is soluble in the Alpha range. The change to hardenite is somewhat advanced when Ac1 merges into Ac2 at about 720 deg. C. owing to these points always overlapping in the heating curve. The hardenite areas probably remain unchanged on the sites previously occupied by the pearlite till the Gamma range Ac3 is reached (at about 810 deg. C.), when the hardenite and ferrite dissolve into each other, forming a homogeneous molecular mixture.

In a saturated steel there is, on heating, a single absorption of heat at the change point Ac1.2.3, the amplitude of which ranges from about 710 deg. C. to 730 deg. C. This change marks the transformation of the whole mass from pearlite into hardenite.

On cooling, there is a very considerable evolution of heat at the single point Ar1.2.3, the amplitude of which ranges from about 690 deg. C to 660 deg. C. This recalescence marks the transformation of hardenite into pearlite. The particular phase of pearlite obtained depends upon the rate of cooling from 660 deg. C. to atmospheric temperature. The emulsified phase is produced by very rapid cooling, normal pearlite by ordinary cooling, and laminated pearlite



TRANSFORMATIONS OF A SUPERSATURATED STEEL.
Carbon 1.5 per cent. Rapidly quenched from [illegible]° C. [illegible] °C.

by very slow cooling. Pearlite, in which the carbide is emulsified or "sorbitic," may also be produced [illegible] hardenite.

The micrographic and thermal transformations [illegible] saturated steel are as follows: At Ac1.2.3 the sectional ground mass of pearlite changes to hardenite, the cementite slowly segregates into larger masses until a temperature of about 900 deg. C. is reached, then the cementite and hardenite dissolve one into the other, and a homogeneous mass of hardenite and cementite is obtained.

On cooling, at about 900 deg. C. the cementite falls out with a faint evolution of heat, and is completely segregated long before the point Ar1.2.3 is reached, hence the micrographic transformations of cementite and hardenite are quite unconnected with the three thermal critical points or any of them, and are due entirely to the influence of temperature.

The authors much regret that in certain respects their views are fundamentally but conscientiously opposed to those of the distinguished French metallographist, Mr. Floris Osmond. This fact makes it the more necessary for them to ask those members of the Institute interested in the matter to refer back to Mr. Osmond's paper on the "Critical Points of Iron and Steel," Journal of the Iron and Steel Institute, 1890, No. I. p. 38, and after an interval of nearly fifteen years to note the brilliant accuracy of his pioneer work on the thermal points presented by iron and steel, and also that his chronographic inverse-rate method of registering the observed thermal curves is still unsurpassed for general utility in researches on the critical points of iron and steel.

PROF. JOHN OLIVER ARNOLD.

SEGREGATION IN STEEL INGOTS.

By B. Talbot (Middlesbrough).

The author has felt some little trepidation in bringing a paper on the above subject before the members of the Institute. On the one hand, the facts set forth in the following pages are, in a general way, known to all practical steel manufacturers and engineers, whilst on the other hand there has been rather a tendency in many quarters to ignore the subject as one into which it is perhaps better not to make too close an investigation.

The fact that segregation takes place in ingots appears to have been first discovered by Mr. Stubbs, who brought it before the notice of the Institute in the discussion on a paper by Mr. Parry, read in [illegible].* The subject was then taken up by Mr. [illegible], who published his results in the same year, completely confirming Mr. Stubbs's earlier observations.† Some years later Mr. Eccles read a paper before the Institute on an imperfection in mild steel plates considered chemically,‡ in which the effects of segregation in plates were clearly set forth. Since that date other observers have from time to time drawn attention to the subject, such as the paper by Hogg read before the Society of Chemical Industry,§ and one by Pourcel read at the Chicago meeting of the American Institute of Mining Engineers in 1893. There is also a good *résumé* of the subject in Howe's work on the Metallurgy of Steel.

Although the above papers draw attention to the effects of segregation in ingots and rolled products, very little appears to have been published as regards any means of lessening the amount of such segregation. It appears to have been pointed out by Pourcel as early as 1893 that aluminium has a decided tendency to prevent segregation, but the author has not met with any systematic series of tests to prove the point. The following results, therefore, in which parallel tests have been made on ingots from the same heat, with and without the addition of a small amount of aluminium to the ingot, may prove of interest.

The ingots taken for examination were from both acid and basic open-hearth furnaces, and varied in weight from about 1½ to 3½ tons, and it may be noted here in passing that the smaller ingot showed the effect of segregation quite as distinctly, if not more so, than the bigger ingots tested.

The height of the ingots was about 5 ft. 6 in., and figs. 1 and 2 have been prepared in order to show how the drillings were taken over the whole surface of the divided ingot.

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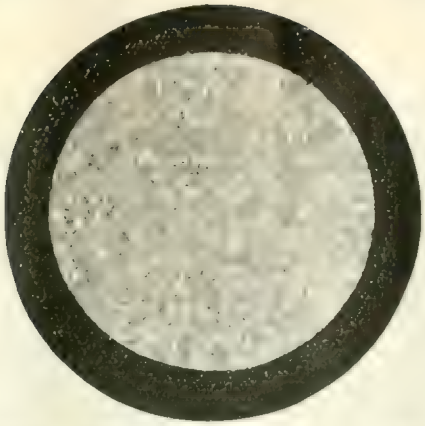
* Journal of the Iron and Steel Institute, 188[illegible], No. [illegible]

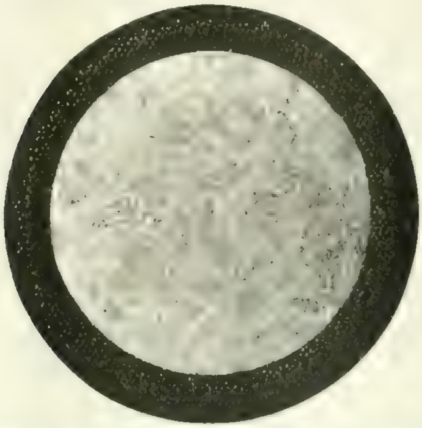
† Ibid., No. II. p. 37[illegible]

‡ Ibid., 188[illegible], No. I. p. [illegible]

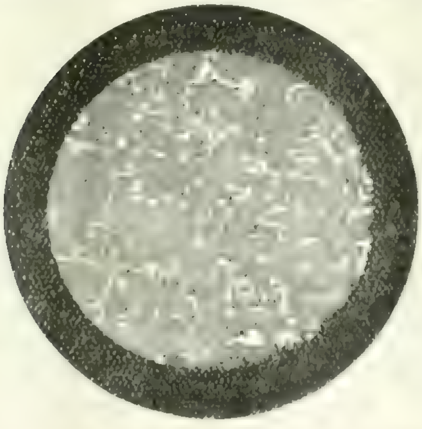
§ Journal of the Society of Chemical Industry, Vol. [illegible], p. 2[illegible]



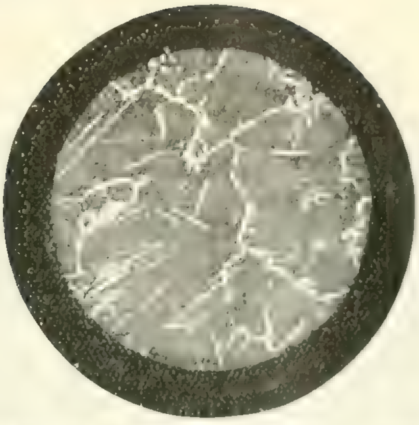
Micrograph No. 7.—Supersaturated Steel. Carbon 1·78 per cent. in normal condition. Dominating structure.



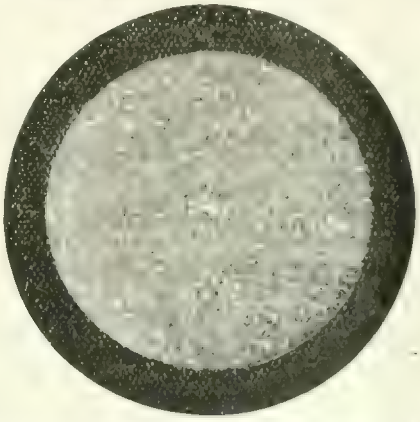
Micrograph No. 8.—Supersaturated Steel. Carbon 1·78 per cent. normal condition. Cellular structure found here and there in same section as Micrograph No. 7.



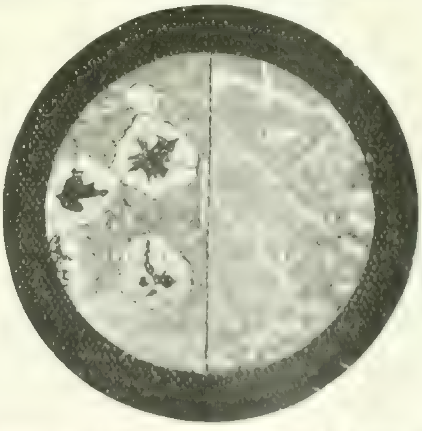
Micrograph No. 9.—Supersaturated Steel. Carbon, 1·78 per cent. Structure like Micrograph No. 7. Quenched at 750 C.



Micrograph No. 10.—Supersaturated Steel. Carbon, 1·78 per cent. Structure like Micrograph No. 8. Quenched at 845° C.



Micrograph No. 11.—Supersaturated Steel. Carbon, 1·78 per cent, Same as that figured in Micrographs Nos. 7, 8, 9, and 10, but quenched at 775° C.



Micrograph No. 12.—[illegible] Graphite and Ferrite [illegible] per cent. ; Si = 0·50 per cent. ; Mn = 0·15 per cent. ; Graphite in annealed section, 1·38 per cent. Combined carbon, 0·42 per cent.

MICROGRAPHS ILLUSTRATING THE THERMAL TRANSFORMATIONS OF CARBON STEELS.

TABLE A.—*Analyses made on a 20-inch by 24-inch by 68-inch Acid Steel Ingot. Heat D, 2072. Weight of Ingot, 7500 lbs.*

Ingot was bottom poured, allowed to cool, and was then cut through the centre of the 20-inch side longitudinally. Drillings were taken from holes ⅝ inch diameter by ¾ inch deep on planed surface at intersection of lettered and numbered lines as shown on Fig. 1.

No.		A.	B.	C.	D.	E.	F.	G.	H.	I.	Average.
1	Carbon	0·33	0·35	0·31	0·30	0·32	0·34	0·31	0·33	0·35	0·330
	Sulphur	0·042	0·039	0·023	0·024	0·037	0·033	0·030	0·036	0·041	0·0339
	Phosphorus	0·036	0·039	0·032	0·034	0·039	0·034	0·037	0·039	0·042	0·0368
	Manganese	0·55	0·52	0·51	0·52	0·50	0·53	0·52	0·52	0·51	0·520
2	Carbon	0·38	0·42	0·46	0·57	0·47	0·55	0·48	0·43	0·34	0·456
	Sulphur	0·043	0·059	0·069	0·105	0·071	0·094	0·073	0·067	0·039	0·0689
	Phosphorus	0·040	0·059	0·063	0·092	0·067	0·079	0·064	0·055	0·037	0·0618
	Manganese	0·56	0·53	0·56	0·58	0·57	0·57	0·59	0·54	0·53	0·559
3	Carbon	0·35	0·47	0·46	0·59	0·60	0·60	0·45	0·47	0·36	0·483
	Sulphur	0·039	0·083	0·069	0·121	0·173	0·129	0·069	0·077	0·032	0·0880
	Phosphorus	0·043	0·068	0·068	0·098	0·127	0·098	0·061	0·067	0·043	0·0749
	Manganese	0·51	0·53	0·56	0·59	0·60	0·60	0·57	0·56	0·50	0·558
4	Carbon	0·35	0·46	0·50	0·48	0·67	0·51	0·50	0·50	0·37	0·482
	Sulphur	0·036	0·083	0·080	0·081	0·183	0·080	0·079	0·083	0·049	0·0839
	Phosphorus	0·041	0·070	0·071	0·072	0·134	0·074	0·076	0·070	0·044	0·0724
	Manganese	0·49	0·54	0·58	0·57	0·63	0·56	0·57	0·57	0·52	0·559
5	Carbon	0·37	0·48	0·50	0·42	0·65	0·48	0·50	0·46	0·35	0·468
	Sulphur	0·043	0·072	0·088	0·063	0·185	0·077	0·087	0·081	0·045	0·0823
	Phosphorus	0·047	0·071	0·078	0·065	0·134	0·065	0·070	0·067	0·047	0·0704
	Manganese	0·52	0·54	0·57	0·55	0·60	0·56	0·58	0·59	0·53	0·559
6	Carbon	0·36	0·47	0·47	0·46	0·54	0·46	0·47	0·46	0·37	0·451
	Sulphur	0·041	0·071	0·084	0·081	0·114	0·075	0·085	0·080	0·041	0·0767
	Phosphorus	0·042	0·063	0·075	0·070	0·092	0·061	0·073	0·069	0·041	0·0651
	Manganese	0·50	0·54	0·58	0·57	0·58	0·56	0·57	0·57	0·53	0·556
7	Carbon	0·36	0·43	0·42	0·43	0·43	0·44	0·43	0·45	0·38	0·419
	Sulphur	0·045	0·075	0·074	0·069	0·075	0·070	0·065	0·075	0·038	0·0649
	Phosphorus	0·047	0·068	0·060	0·061	0·065	0·061	0·070	0·064	0·045	0·0590
	Manganese	0·57	0·56	0·54	0·55	0·54	0·57	0·57	0·55	0·54	0·556
8	Carbon	0·36	0·46	0·42	0·42	0·38	0·41	0·43	0·45	0·39	0·413
	Sulphur	0·043	0·083	0·071	0·068	0·062	0·062	0·069	0·071	0·039	0·0631
	Phosphorus	0·040	0·068	0·058	0·057	0·055	0·056	0·064	0·066	0·045	0·0566
	Manganese	0·53	0·56	0·55	0·56	0·54	0·57	0·56	0·56	0·54	0·552
9	Carbon	0·37	0·45	0·44	0·40	0·39	0·41	0·44	0·45	0·39	0·413
	Sulphur	0·044	0·077	0·080	0·062	0·063	0·061	0·081	0·075	0·044	0·0653
	Phosphorus	0·045	0·070	0·067	0·056	0·051	0·057	0·070	0·065	0·046	0·0586
	Manganese	0·53	0·58	0·56	0·54	0·55	0·57	0·56	0·56	0·54	0·556
10	Carbon	0·38	0·46	0·43	0·43	0·40	0·42	0·43	0·45	0·40	0·422
	Sulphur	0·053	0·078	0·067	0·073	0·058	0·062	0·069	0·074	0·047	0·0646
	Phosphorus	0·043	0·070	0·058	0·063	0·058	0·060	0·059	0·065	0·044	0·0557
	Manganese	0·54	0·56	0·56	0·56	0·56	0·55	0·55	0·56	0·54	0·553
11	Carbon	0·38	0·42	0·41	0·40	0·39	0·40	0·42	0·43	0·40	0·406
	Sulphur	0·048	0·069	0·066	0·066	0·059	0·059	0·067	0·067	0·050	0·0607
	Phosphorus	0·054	0·065	0·057	0·057	0·059	0·051	0·060	0·063	0·046	0·0572
	Manganese	0·55	0·56	0·54	0·56	0·54	0·57	0·56	0·55	0·56	0·554
12	Carbon	0·39	0·43	0·45	0·42	0·41	0·43	0·44	0·44	0·39	0·422
	Sulphur	0·046	0·067	0·069	0·058	0·058	0·069	0·071	0·069	0·043	0·0611
	Phosphorus	0·048	0·061	0·056	0·057	0·060	0·062	0·062	0·062	0·046	0·0573
	Manganese	0·56	0·56	0·55	0·55	0·54	0·56	0·56	0·56	0·57	0·557

Average of the whole ingot: C, 0·429; S, 0·0678; P, 0·0607; Mn, 0·553.
Analysis of ladle test: C, 0·43; S, 0·069; P, 0·062; Mn, 0·55.

TABLE B.—*Analyses made on a 13-inch by 16-inch by 68-inch Acid Steel Ingot. Heat D, 2072. Weight of Ingot, 3000 lbs.*

Ingot was bottom poured, allowed to cool, and was then cut through the centre of the 13-inch side longitudinally. Drillings were taken from holes ⅝ inch diameter by ¾ inch deep on planed surface at intersection of lettered and numbered lines as shown on Fig. 2.

No.		A.	B.	C.	E.	G.	H.	I.	Average.
1	Carbon	0·37	0·38	0·38	0·38	0·35	0·37	0·42	0·379
	Sulphur	0·051	0·049	0·045	0·039	0·054	0·055	0·062	0·0492
	Phosphorus	0·050	0·044	0·047	0·044	0·045	0·054	0·064	0·0497
	Manganese	0·52	0·54	0·57	0·52	0·53	0·50	0·54	0·540
2	Carbon	0·37	0·38	0·50	0·62	0·48	0·38	0·37	0·443
	Sulphur	0·039	0·045	0·083	0·185	0·088	0·044	0·042	0·0749
	Phosphorus	0·041	0·044	0·072	0·136	0·074	0·052	0·046	0·0664
	Manganese	0·53	0·54	0·55	0·58	0·58	0·52	0·53	0·550
3	Carbon	0·36	0·43	0·51	0·67	0·45	0·41	0·38	0·463
	Sulphur	0·040	0·062	0·085	0·184	0·081	0·049	0·044	0·0779
	Phosphorus	0·035	0·057	0·077	0·150	0·075	0·052	0·047	0·0704
	Manganese	0·50	0·54	0·57	0·61	0·58	0·55	0·53	0·553
4	Carbon	0·37	0·46	0·48	0·74	0·44	0·44	0·37	0·471
	Sulphur	0·041	0·078	0·077	0·277	0·068	0·057	0·039	0·0906
	Phosphorus	0·040	0·067	0·069	0·161	0·062	0·057	0·036	0·0703
	Manganese	0·52	0·57	0·56	0·64	0·55	0·55	0·52	0·560
5	Carbon	0·36	0·47	0·48	0·55	0·46	0·45	0·39	0·451
	Sulphur	0·043	0·079	0·075	0·133	0·076	0·071	0·045	0·0746
	Phosphorus	0·041	0·068	0·074	0·106	0·070	0·060	0·057	0·0680
	Manganese	0·52	0·55	0·58	0·58	0·57	0·56	0·53	0·554
6	Carbon	0·36	0·47	0·50	0·51	0·46	0·46	0·37	0·447
	Sulphur	0·048	0·082	0·088	0·112	0·084	0·077	0·038	0·0756
	Phosphorus	0·047	0·068	0·085	0·089	0·071	0·070	0·043	0·0678
	Manganese	0·53	0·55	0·56	0·57	0·57	0·55	0·53	0·551
7	Carbon	0·37	0·45	0·44	0·47	0·43	0·46	0·39	0·430
	Sulphur	0·052	0·079	0·076	0·104	0·075	0·080	0·046	0·0724
	Phosphorus	0·046	0·065	0·067	0·076	0·060	0·069	0·049	0·0617
	Manganese	0·53	0·57	0·55	0·57	0·55	0·55	0·54	0·552
8	Carbon	0·38	0·46	0·42	0·47	0·43	0·47	0·38	0·430
	Sulphur	0·047	0·080	0·074	0·077	0·070	0·084	0·045	0·0681
	Phosphorus	0·052	0·065	0·061	0·074	0·067	0·069	0·049	0·0624
	Manganese	0·52	0·56	0·57	0·57	0·57	0·57	0·54	0·560
9	Carbon	0·38	0·46	0·41	0·46	0·42	0·47	0·39	0·427
	Sulphur	0·045	0·082	0·067	0·067	0·068	0·077	0·048	0·0649
	Phosphorus	0·047	0·066	0·055	0·058	0·061	0·066	0·048	0·0573
	Manganese	0·53	0·55	0·55	0·57	0·55	0·56	0·52	0·550
10	Carbon	0·38	0·45	0·41	0·43	0·43	0·45	0·38	0·419
	Sulphur	0·054	0·080	0·070	0·071	0·069	0·068	0·048	0·0657
	Phosphorus	0·054	0·064	0·065	0·062	0·061	0·066	0·050	0·0603
	Manganese	0·53	0·54	0·55	0·56	0·55	0·56	0·53	0·546
11	Carbon	0·37	0·45	0·41	0·42	0·42	0·44	0·38	0·413
	Sulphur	0·059	0·082	0·066	0·065	0·071	0·078	0·057	0·0670
	Phosphorus	0·052	0·065	0·061	0·059	0·065	0·065	0·063	0·0601
	Manganese	[illegible]	[illegible]	0·51	0·55	0·56	[illegible]	0·54	[illegible]
12	Carbon	0·37	0·44	0·42	0·41	0·42	0·44	0·40	0·413
	Sulphur	0·058	0·079	0·065	0·057	0·068	0·071	0·048	0·0630
	Phosphorus	0·048	0·061	0·058	0·057	0·063	0·063	0·054	0·0577
	Manganese	0·54	0·56	0·57	0·55	0·56	0·55	0·53	0·551

Average of the whole ingot: C, 0·432; S, 0·0704; P, 0·0626; Mn, 0·552.
Analysis of ladle test: C, 0·43; S, 0·069; P, 0·062; Mn, 0·55.

TABLE C.—*Analyses made on an 18-inch by 22-inch by 67-inch Acid Steel Ingot. Heat D, 2086. Weight of Ingot, 6000 lbs.*

Ingot was top poured with the addition of 4 ozs. aluminium to the ton of steel, allowed to cool, and was then cut through the centre of the 18-inch side longitudinally. Drillings were taken from holes ⅝-inch diameter by ¾-inch deep, on planed surface at intersection of lettered and numbered lines as shown on Fig. 1.

No.		A	B	C.	D	E	F	G.	H	I.	Average.
1	Carbon	0·39	0·35	0·31	0·33	0·32	0·32	0·31	0·39	0·41	0·348
	Sulphur	0·067	0·034	0·033	0·041	0·038	0·038	0·035	0·053	0·058	0·0430
	Phosphorus	0·054	0·038	0·034	0·036	0·035	0·030	0·037	0·052	0·053	0·0420
	Manganese	0·52	0·52	0·52							0·520
2	Carbon	0·30	0·41	0·36	0·31	0·35	0·36	0·39	0·42	0·42	0·379
	Sulphur	0·066	0·067	0·058	0·035	0·042	0·048	0·050	0·059	0·057	0·0536
	Phosphorus	0·057	0·056	0·045	0·035	0·040	0·045	0·048	0·055	0·053	0·482
	Manganese	0·52	0·51	0·53							0·520
3	Carbon	0·39	0·42	0·42	0·40	0·48	0·41	0·41	0·43	0·41	0·426
	Sulphur	[illegible]	0·062	0·071	[illegible]	0·078	0·065	0·068	0·063	0·052	0·0654
	Phosphorus	[illegible]	[illegible]	0·048	0·052	0·064	0·058	0·056	0·053	0·052	0·0549
	Manganese	[illegible]	0·52	0·52							0·517
4	Carbon	0·40	[illegible]	[illegible]	0·43	0·45	0·45	0·45	0·42	0·45	0·433
	Sulphur	[illegible]	[illegible]	[illegible]	0·074	0·086	0·068	0·070	0·064	0·058	0·0678
	Phosphorus	[illegible]	[illegible]	[illegible]	0·060	0·063	0·066	0·059	0·054	0·053	0·0583
	Manganese	[illegible]	[illegible]	[illegible]							0·523
5	Carbon	0·47	0·45	[illegible]	0·43	0·34	0·43	0·46	0·40	0·35	0·418
	Sulphur	0·068	0·069	0·076	0·064	0·081	0·070	0·073	0·062	0·053	0·0690
	Phosphorus	[illegible]	[illegible]	[illegible]	0·056	0·049	0·065	0·061	0·057	0·050	0·0568
	Manganese	[illegible]	[illegible]	[illegible]							0·530
6	Carbon	0·42	0·45	0·43	0·42	0·38	0·40	0·47	0·42	0·37	0·418
	Sulphur	0·060	0·070	0·072	0·066	0·059	0·065	0·078	0·064	0·050	0·0656
	Phosphorus	0·058	0·057	0·060	0·063	0·054	0·057	0·060	0·055	0·048	0·0558
	Manganese	[illegible]	[illegible]	[illegible]							0·527
7	Carbon	0·41	[illegible]	0·42	0·40	0·38	0·38	0·44	0·40	0·37	0·406
	Sulphur	[illegible]	[illegible]	0·068	0·051	0·067	0·062	0·066	0·054	0·059	0·0637
	Phosphorus	[illegible]	[illegible]	[illegible]	0·051	0·052	0·052	0·059	0·057	0·052	0·0543
	Manganese	[illegible]	[illegible]	[illegible]							0·523
8	Carbon	0·41	[illegible]	0·41	[illegible]	[illegible]	[illegible]	0·42	0·41	0·36	0·398
	Sulphur	[illegible]	[illegible]	[illegible]	0·074	0·057	0·061	0·064	0·063	0·053	0·0621
	Phosphorus	[illegible]	[illegible]	[illegible]	0·054	0·049	[illegible]	0·054	0·054	0·050	0·0529
	Manganese	[illegible]	[illegible]	[illegible]							0·520
9	Carbon	0·40	[illegible]	0·41	0·37	[illegible]	[illegible]	0·40	0·42	0·37	0·390
	Sulphur	[illegible]	[illegible]	[illegible]	0·057	[illegible]	0·057	0·055	0·064	0·043	0·0574
	Phosphorus	[illegible]	[illegible]	[illegible]	0·047	0·049	0·051	0·055	0·056	0·047	0·0522
	Manganese	[illegible]	[illegible]	[illegible]							0·527
10	Carbon	[illegible]	[illegible]	0·40	[illegible]	0·36	0·35	0·40	0·44	0·37	0·384
	Sulphur	[illegible]	[illegible]	[illegible]	[illegible]	0·056	[illegible]	0·058	[illegible]	0·046	0·0580
	Phosphorus	[illegible]	[illegible]	0·048	[illegible]	[illegible]	0·048	0·052	[illegible]	0·048	0·0517
	Manganese	[illegible]	[illegible]	[illegible]							0·517
11	Carbon	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0·38	0·41	0·34	0·378
	Sulphur	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0·056	0·063	0·070	0·0562
	Phosphorus	[illegible]	[illegible]	[illegible]	[illegible]	0·047	0·050	0·052	0·053	0·047	0·0504
	Manganese	[illegible]	[illegible]	[illegible]							0·520
12	Carbon	[illegible]	[illegible]	[illegible]	[illegible]	0·38	0·37	0·39	0·42	0·37	0·389
	Sulphur	[illegible]	[illegible]	[illegible]	0·056	0·063	0·062	0·059	0·063	0·043	0·0590
	Phosphorus	[illegible]	[illegible]	[illegible]	0·052	0·044	0·051	0·055	0·053	0·045	0·0517
	Manganese	[illegible]	[illegible]	[illegible]							0·523

Average of the whole ingot: C, 0·397; S, 0·0601; P, 0·0524; Mn, 0·522.
Analysis of ladle test ingot: C, 0·38; S, 0·061; P, 0·052; Mn, 0·52.

TABLE D.—*Analyses made on an 18-inch by 22-inch by 67-inch Acid Steel Ingot. Heat D, 2086. Weight of Ingot, 6000 lbs.*

Ingot was top poured without the addition of aluminium, allowed to cool and was then cut through the centre on the 18-inch side longitudinally. Drillings were taken from holes ⅝-inch diameter by ¾-inch deep, on planed surface at intersection of lettered and numbered lines as shown on Fig. 1.

No.		A.	B	C.	D.	E.	F.	G.	H.	I	Average
1	Carbon	0·33	0·49	0·29	0·33	0·11	0·28	0·29	0·24	0·33	0·332
	Sulphur	0·035	0·078	0·022	0·039	0·053	0·028	0·028	0·022	0·063	0·0409
	Phosphorus	0·047	0·070	0·032	0·046	0·051	0·033	0·031	0·029	0·053	0·0424
	Manganese	0·47	0·55	0·50	0·50	0·53	0·50	0·50	0·51	0·51	0·508
2	Carbon	0·32	0·39	0·41	0·67	0·39	0·55	0·46	0·36	0·32	0·430
	Sulphur	0·071	0·035	0·039	0·153	0·049	0·081	0·067	0·038	0·038	0·0590
	Phosphorus	0·034	0·045	0·044	0·109	0·052	0·079	0·061	0·043	0·036	0·0559
	Manganese	0·49	0·53	0·52	0·59	0·52	0·59	0·55	0·52	0·52	0·537
3	Carbon	0·31	0·37	0·54	0·70	0·95	0·62	0·51	0·39	0·29	0·520
	Sulphur	0·018	0·041	0·068	0·161	0·267	0·107	0·079	0·044	0·022	0·0891
	Phosphorus	0·030	0·046	0·068	0·135	0·197	0·095	0·072	0·047	0·028	0·0798
	Manganese	0·50	0·53	0·51	0·64	0·59	0·62	0·56	0·54	0·51	0·567
4	Carbon	0·32	0·42	0·55	0·54	0·59	0·54	0·59	0·39	0·32	0·495
	Sulphur	0·027	0·061	0·084	0·097	0·141	0·173	0·106	0·048	0·027	0·0849
	Phosphorus	0·036	0·057	0·075	0·086	0·109	0·112	0·080	0·049	0·035	0·0710
	Manganese	0·50	0·51	0·55	0·54	0·61	0·66	0·57	0·53	0·52	0·559
5	Carbon	0·35	0·41	0·46	0·45	0·47	0·51	0·48	0·40	0·36	0·436
	Sulphur	0·031	0·059	0·053	0·066	0·097	0·073	0·067	0·055	0·039	0·0603
	Phosphorus	0·040	0·062	0·055	0·059	0·083	0·072	0·060	0·048	0·042	0·0546
	Manganese	0·51	0·50	0·53	0·56	0·59	0·61	0·53	0·54	0·53	0·541
6	Carbon	0·37	0·39	0·42	0·40	0·46	0·39	0·42	0·41	0·42	0·409
	Sulphur	0·036	0·054	0·053	0·052	0·081	0·059	0·061	0·058	0·056	0·0567
	Phosphorus	0·046	0·060	0·052	0·052	0·065	0·054	0·055	0·054	0·051	0·0534
	Manganese	0·50	0·52	0·52	0·55	0·56	0·54	0·52	0·55	0·54	0·531
7	Carbon	0·38	0·46	0·41	0·37	0·46	0·38	0·39	0·42	0·41	0·409
	Sulphur	0·040	0·056	0·058	0·053	0·056	0·052	0·059	0·068	0·060	0·0591
	Phosphorus	0·048	0·062	0·052	0·052	0·061	0·054	0·049	0·055	0·063	0·0551
	Manganese	0·51	0·52	0·55	0·52	0·54	0·50	0·52	0·55	0·54	0·526
8	Carbon	0·38	0·45	0·39	0·36	0·38	0·37	0·39	0·42	0·40	0·393
	Sulphur	0·041	0·061	0·051	0·047	0·056	0·054	0·055	0·064	0·051	0·0537
	Phosphorus	0·046	0·055	0·053	0·050	0·053	0·048	0·051	0·055	0·052	0·0514
	Manganese	0·52	0·52	0·52	0·53	0·52	0·53	0·51	0·54	0·53	0·524
9	Carbon	0·36	0·45	0·44	0·36	0·35	0·39	0·42	0·42	0·39	0·398
	Sulphur	0·039	0·061	0·057	0·049	0·045	0·052	0·058	0·068	0·051	0·0531
	Phosphorus	0·044	0·059	0·056	0·049	0·045	0·048	0·053	0·059	0·049	0·0513
	Manganese	0·52	0·53	0·54	0·52	0·54	0·52	0·52	0·55	0·54	0·528
10	Carbon	0·38	0·46	0·40	0·37	0·35	0·38	0·40	0·41	0·40	0·394
	Sulphur	0·041	0·058	0·058	0·050	0·048	0·055	0·056	0·061	0·056	0·0547
	Phosphorus	0·046	0·059	0·053	0·050	0·047	0·049	0·049	0·056	0·052	0·0512
	Manganese	0·52	0·55	0·53	0·53	0·54	0·52	0·52	0·54	0·55	0·528
11	Carbon	0·41	0·41	0·37	[illegible]	0·34	[illegible]	0·38	0·39	0·37	0·379
	Sulphur	0·048	[illegible]	0·056	0·041	0·047	0·050	0·054	0·062	0·050	0·0515
	Phosphorus	0·045	[illegible]	0·050	[illegible]	0·045	0·046	0·049	0·052	0·054	0·0491
	Manganese	0·61	0·52	0·52	0·51	0·52	0·50	0·54	0·53	0·54	0·518
12	Carbon	0·43	0·39	0·34	0·36	0·31	0·36	0·40	0·41	0·38	[illegible]
	Sulphur	0·063	0·046	0·054	0·052	0·051	0·047	0·057	0·063	0·058	[illegible]
	Phosphorus	0·054	0·048	0·063	0·053	0·050	0·048	0·052	0·053	0·050	[illegible]
	Manganese	0·51	0·51	0·55	0·52	0·53	0·51	0·51	0·54	0·53	0·521

Average of the whole ingot: C, 0·416; S, 0·0597; P, 0·0555; Mn, 0·532.
Analysis of ladle test: C, 0·38; S, 0·061; P, 0·052; Mn, 0·52.

MR. F. TALBOT'S RESEARCHES ON SEGREGATION IN STEEL INGOTS.

TABLE E.—*Analyses made on a 20-inch by 24-inch by 65-inch Basic Steel Ingot. Heat H, 187. Weight, 7500 lbs.*

Ingot was top poured, with the addition of 10 ozs. of aluminium to the ingot (inverted), allowed to cool and was then cut through the centre of 20-inch side. Drillings were taken from holes ¾-inch diameter by ¼-inch deep on planed surface at intersection of lettered and numbered lines as shown on Fig. 1.

No.		A	B	C	D	E.	F.	G	H	I	Average.
1	Carbon	0·46	0·52	0·43	0·45	0·43	0·43	0·46	0·45	0·44	0·452
	Sulphur	0·043	0·057	0·031	0·035	0·030	0·034	0·030	0·043	0·049	0·0391
	Phosphorus	0·032	0·038	0·035	0·029	0·023	0·025	0·025	0·033	0·033	0·0292
	Manganese	0·59	0·61	0·57	0·56	0·58	0·51	0·59	0·62	0·59	0·591
2	Carbon	0·44	0·52	0·75	0·63	0·61	0·69	0·71	0·51	0·44	0·589
	Sulphur	0·039	0·058	0·121	0·081	0·078	0·118	0·114	0·054	0·043	0·0784
	Phosphorus	0·030	0·039	0·072	0·046	0·046	0·060	0·060	0·034	0·029	0·0467
	Manganese	0·60	0·62	0·64	0·58	0·63	0·63	0·63	0·61	0·63	0·619
3	Carbon	0·50	0·53	0·58	0·56	0·55	0·52	0·58	0·53	0·45	0·533
	Sulphur	0·041	0·042	0·065	0·071	0·064	0·063	0·066	0·059	0·047	0·0576
	Phosphorus	0·031	0·032	0·052	0·044	0·038	0·040	0·045	0·038	0·031	0·0390
	Manganese	0·61	0·62	0·62	0·60	0·58	0·62	0·62	0·61	0·62	0·613
4	Carbon	0·47	0·53	0·59	0·52	0·53	0·52	0·58	0·53	0·49	0·529
	Sulphur	0·051	0·054	0·055	0·066	0·060	0·064	0·064	0·072	0·053	0·0610
	Phosphorus	0·035	0·036	0·046	0·042	0·036	0·039	0·044	0·041	0·036	0·0394
	Manganese	0·59	0·63	0·62	0·60	0·59	0·62	0·62	0·62	0·62	0·613
5	Carbon	0·49	0·55	0·56	0·57	0·53	0·57	0·57	0·52	0·49	0·539
	Sulphur	0·047	0·060	0·068	0·071	0·064	0·075	0·068	0·070	0·052	0·0639
	Phosphorus	0·036	0·039	0·043	0·046	0·041	0·044	0·045	0·039	0·035	0·0409
	Manganese	0·59	0·62	0·61	0·63	0·60	0·64	0·63	0·62	0·63	0·619
6	Carbon	0·47	0·57	0·55	0·61	0·61	0·57	0·56	0·55	0·47	0·551
	Sulphur	0·052	0·061	0·069	0·073	0·084	0·071	0·064	0·066	0·052	0·0658
	Phosphorus	0·034	0·038	0·039	0·034	0·048	0·033	0·042	0·039	0·035	0·0402
	Manganese	0·60	0·62	0·62	0·63	0·60	0·63	0·61	0·62	0·61	0·619
7	Carbon	0·46	0·59	0·58	0·62	0·66	0·55	0·55	0·53	0·49	0·558
	Sulphur	0·045	0·067	0·064	0·084	0·095	0·068	0·066	0·068	0·055	0·0680
	Phosphorus	0·033	0·040	0·040	0·047	0·050	0·043	0·044	0·039	0·038	0·0413
	Manganese	0·60	0·63	0·60	0·62	0·63	0·62	0·62	0·62	0·62	0·620
8	Carbon	0·46	0·60	0·56	0·56	0·80	0·54	0·56	0·56	0·46	0·563
	Sulphur	0·048	0·069	0·064	0·070	0·165	0·067	0·059	0·068	0·050	0·0734
	Phosphorus	0·035	0·040	0·035	0·041	0·092	0·042	0·041	0·040	0·033	0·0443
	Manganese	0·60	0·62	0·62	0·63	0·69	0·63	0·63	0·62	0·63	0·630
9	Carbon	0·46	0·58	0·56	0·52	0·59	0·53	0·54	0·54	0·47	0·532
	Sulphur	0·043	0·067	0·058	0·052	0·067	0·060	0·084	0·070	0·048	0·0621
	Phosphorus	0·029	0·040	0·041	0·035	0·048	0·037	0·042	0·044	0·030	0·0384
	Manganese	0·59	0·62	0·63	0·60	0·62	0·60	0·60	0·63	0·60	0·610
10	Carbon	0·47	0·55	0·51	0·51	0·51	0·50	0·50	0·52	0·43	0·500
	Sulphur	0·047	0·064	0·040	0·056	0·067	0·047	0·056	0·066	0·041	0·0538
	Phosphorus	0·031	0·039	0·031	0·037	0·038	0·033	0·037	0·043	0·027	0·0351
	Manganese	0·61	0·62	0·63	0·62	0·61	0·61	0·61	0·63	0·61	0·617
11	Carbon	0·47	0·53	0·50	0·51	0·77	0·55	0·49	0·52	0·45	0·532
	Sulphur	0·045	0·058	0·048	0·062	0·165	0·092	0·050	0·070	0·050	0·0711
	Phosphorus	0·028	0·038	0·032	0·036	0·095	0·054	0·031	0·043	0·031	0·0431
	Manganese	0·61	0·62	0·60	0·60	0·67	0·63	0·61	0·61	0·61	0·617
12	Carbon	0·46	0·50	0·50	0·50	0·47	0·47	0·46	0·48	0·51	0·463
	Sulphur	0·050	0·050	0·048	0·050	0·047	0·045	0·047	0·054	0·047	0·0487
	Phosphorus	0·029	0·030	0·033	0·033	0·034	0·035	0·041	0·035	0·034	0·0338
	Manganese	0·62	0·61	0·60	0·58	0·60	0·60	0·60	0·61	0·60	0·602

Average of the whole ingot: C, 0·530; S, 0·0619; P, 0·0393; Mn, 0·614.
Analysis of ladle test: C, 0·50; S, 0·062; P, 0·040; Mn, 0·62

TABLE F.—*Analyses made on a 20-inch by 24 inch by 65 inch Basic Steel Ingot. Heat H, 187. Weight, 7500 lbs.*

Ingot was top poured, with the addition of 10 ozs. of aluminium to the ingot (in original position), allowed to cool, and was then cut through the centre of 20-inch side longitudinally. Drillings were taken from holes ¾-inch diameter by ¼-inch deep on planed surface at intersection of lettered and numbered lines as shown on Fig. 1.

No.		A.	B.	C.	D	E.	F	G	H	I	Average
1	Carbon	0·44	0·43	0·44	0·45	0·47	0·47	0·45	0·44	0·49	0·453
	Sulphur	0·042	0·039	0·039	0·039	0·034	0·037	0·037	0·042	0·49	0·0420
	Phosphorus	0·064	0·040	0·026	0·026	0·030	0·036	0·025	0·030	0·037	0·0342
	Manganese	0·57	0·58	0·61							0·587
2	Carbon	0·50	0·49	0·49	0·48	0·51	0·51	0·51	0·53	0·50	0·498
	Sulphur	0·063	0·058	0·044	0·051	0·045	0·056	0·056	0·058	0·063	0·0649
	Phosphorus	0·041	0·040	0·033	0·031	0·030	0·037	0·039	0·036	0·040	0·0363
	Manganese	0·60	0·62	0·60							0·610
3	Carbon	0·51	0·51	0·53	0·55	0·64	0·58	0·52	0·55	0·52	0·549
	Sulphur	0·061	0·064	0·064	0·072	0·098	0·094	0·064	0·068	0·067	0·0724
	Phosphorus	0·042	0·043	0·041	0·043	0·055	0·052	0·041	0·045	0·042	0·0447
	Manganese	0·61	0·62	0·63							0·620
4	Carbon	0·52	0·52	0·54	0·59	0·75	0·55	0·55	0·56	0·51	0·566
	Sulphur	0·060	0·062	0·063	0·078	0·121	0·072	0·065	0·068	0·063	0·0724
	Phosphorus	0·038	0·041	0·041	0·043	0·065	0·045	0·045	0·044	0·041	0·0440
	Manganese	0·61	0·63	0·62							0·620
5	Carbon	0·52	0·51	0·54	0·58	0·70	0·54	0·55	0·53	0·51	0·553
	Sulphur	0·063	0·064	0·064	0·067	0·102	0·070	0·065	0·065	0·066	0·0699
	Phosphorus	0·042	0·041	0·041	0·043	0·055	0·041	0·042	0·043	0·039	0·0430
	Manganese	0·63	0·62	0·63							0·627
6	Carbon	0·49	0·53	0·53	0·58	0·55	0·55	0·52	0·55	0·49	0·532
	Sulphur	0·054	0·064	0·064	0·068	0·061	0·075	0·064	0·064	0·059	0·0637
	Phosphorus	0·036	0·041	0·040	0·042	0·038	0·044	0·040	0·041	0·038	0·0400
	Manganese	0·62	0·62	0·62							0·620
7	Carbon	0·47	0·54	0·53	0·56	0·52	0·53	0·53	0·54	0·48	0·541
	Sulphur	0·049	0·068	0·058	0·067	0·061	0·068	0·063	0·067	0·049	0·0611
	Phosphorus	0·034	0·043	0·037	0·042	0·036	0·044	0·041	0·041	0·032	0·0388
	Manganese	0·61	0·63	0·62							0·623
8	Carbon	0·47	0·53	0·56	0·54	0·57	0·53	0·55	0·53	0·47	0·527
	Sulphur	0·046	0·065	0·068	0·068	0·083	0·068	0·069	0·063	0·045	0·0639
	Phosphorus	0·034	0·041	0·041	0·041	0·047	0·043	0·042	0·040	0·029	0·0398
	Manganese	0·62	0·62	0·63							0·623
9	Carbon	0·48	0·53	0·52	0·55	0·54	0·52	0·55	0·52	0·48	0·520
	Sulphur	0·045	0·064	0·064	0·065	0·075	0·063	0·070	0·067	0·044	0·0613
	Phosphorus	0·031	0·042	0·038	0·041	0·042	0·040	0·043	0·041	0·029	0·0386
	Manganese	0·61	0·63	0·62							0·620
10	Carbon	0·47	0·54	0·53	0·53	0·52	0·54	0·53	0·52	0·48	0·518
	Sulphur	0·039	0·060	0·062	0·061	0·063	0·060	0·064	0·065	0·049	0·0581
	Phosphorus	0·029	0·042	0·037	0·039	0·039	0·039	0·040	0·041	0·030	0·0373
	Manganese	0·61	0·61	0·63							0·617
11	Carbon	0·47	0·54	0·51	0·50	0·49	0·51	0·52	0·53	0·47	0·504
	Sulphur	0·044	0·065	0·061	0·055	0·054	0·052	0·059	0·068	0·045	0·0559
	Phosphorus	0·030	0·043	0·037	0·036	0·033	0·034	0·037	0·043	0·030	0·0359
	Manganese	0·62	0·62	0·62							0·620
12	Carbon	0·48	0·49	0·44	0·46	0·52	0·40	0·48	0·48	0·48	0·479
	Sulphur	0·044	0·048	0·043	0·049	0·059	0·050	0·055	0·054	0·043	0·0495
	Phosphorus	0·033	0·034	0·032	0·034	0·040	0·033	0·034	0·031	0·030	0·0334
	Manganese	0·62	0·63	0·61							0·620

Average of the whole ingot: C, 0·518; S, 0·0604; P, 0·0389; Mn, 0·617.
Analysis of ladle test: C, 0·50; S, 0·062; P, 0·040; Mn, 0·62

MR. R. TALBOT'S RESEARCHES ON SEGREGATION IN STEEL INGOTS.

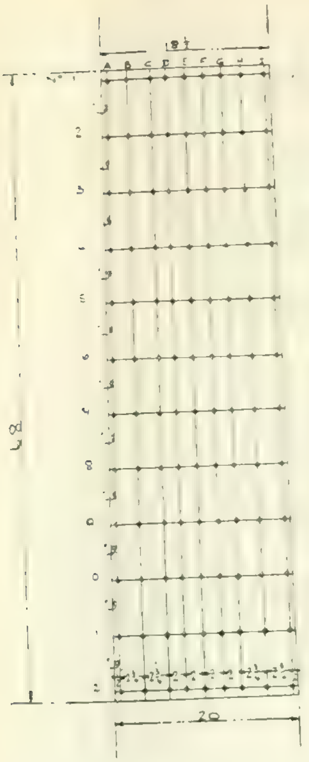


FIG. 1

A

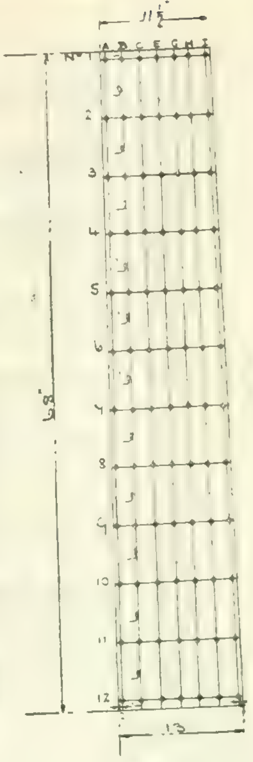


FIG. 2

B

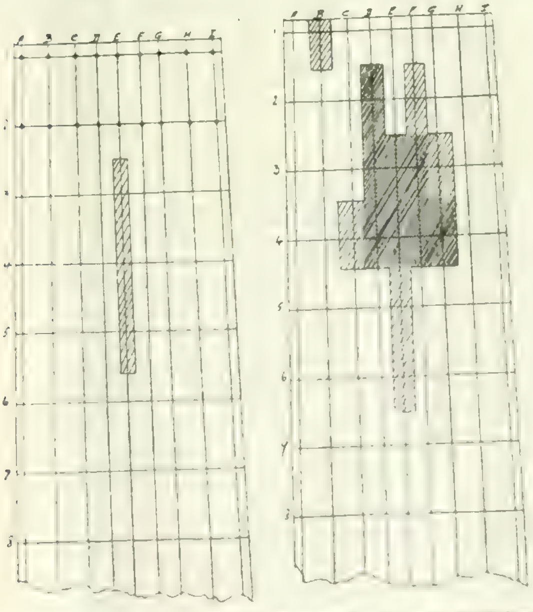


FIG. 3.—Showing Segregation of Sulphur in the same Heat in the case of two Ingots: A, with Aluminium; B, without Aluminium. Parts shaded show the areas in which the sulphur has increased 25 per cent. over ladle test. The darker shading shows approximately areas with over 75 per cent. increase of sulphur.

The heading found at the top of each of the tables given in the accompanying figures sufficiently indicates in what manner the effects of the segregation were looked for both in the ingot and subsequently in the bloom and billet.

As a rule, the results show that in the case of ingots to which no aluminium has been added excessive segregation down the central line of the ingot occurs from about 6 in. from the top to about half way down the ingot, that sulphur is the element which tends to segregate most, phosphorus next, followed by carbon and finally manganese, the segregation of which latter element is so slight as to be almost negligible. No silicon determinations were made as the amount of this element present was extremely small. The analyses given under the heading "Average of the whole ingot," are obtained by taking the average of all the analyses of that ingot, and this average analysis will be found to agree very closely indeed with the analysis of the ladle test. In considering the tables, attention must first be drawn to the fact that the various heats have not been all cast and prepared in the same way. The first two tables, A and B, refer to ingots which were bottom-cast, simultaneously from the same acid steel heat, the only difference being that the one was cast in a larger ingot mould than the other. A portion of the ferro was added in the ladle, but the desired carbon was obtained by catching the metal as it came down.

Tables C and D refer to two acid steel ingots from the same heat, which were cast side by side, but were top poured instead of being bottom poured. Aluminium was added to the ingot in the case of Table C, but none was added in the case of Table D. In this case also the carbon was retained in the bath of steel, which was tapped at the desired percentage.

Tables E and F refer to two ingots from the same heat of fairly high carbon basic steel. These were cast the one following the other, both being top-cast, but in the case of Table F the ingot was inverted immediately after casting.

Table G refers to a mild steel basic ingot, which was also top cast.

Perhaps the chief interest in the foregoing tables centres in a comparison of the segregation shown in the case of the acid steel ingots in Tables C and D, the former with and the latter without the addition of aluminium to an ingot from the same cast of steel. An attempt has been made in Fig. 3 to show by means of a diagram the amount of segregation of the sulphur in these two ingots, and in this case a very marked difference is observable. The shaded portions represent areas on the surface of the ingot when cut through

TABLE G.—*Analyses made on a 20-inch by 24-inch by 66-inch Basic Steel Ingot. Heat F, 548. Weight, 7300 lbs.*

Ingot was [illegible] with the addition of 10 oz. of aluminium to the ingot, allowed to cool, and was then [illegible] the centre of the 20-inch side [illegible]tally. Drillings were taken [illegible] ⅝-inch diameter [illegible] inch deep on planed surface at intersection [illegible] shown in Fig. 1.

		A	B	C	D	E	F	G	H	I	Average.
1	Carbon .	0·11	0·11	0·10	0·10	0·10	0·10	0·10	0·11	0·11	0·104
	Sulphur .	0·064	0·051	0·076	0·047	0·042	0·043	0·041	0·055	0·057	0·0510
	Phosphorus	0·031	0·031	0·034	0·029	0·027	0·026	0·025	0·025	0·031	0·0288
	Manganese	0·49	0·50	0·49	0·48	0·49	0·49	0·48	0·49	0·49	0·490
2	Carbon .	0·11	0·11	0·13	0·19	0·22	0·19	0·13	0·11	0·10	0·143
	Sulphur .	0·069	0·063	0·091	0·069	0·191	0·141	0·079	0·065	0·055	0·1037
	Phosphorus	0·032	0·033	0·041	0·058	0·054	0·054	0·039	0·030	0·030	0·0412
	Manganese	0·50	0·51	0·50	0·50	0·51	0·53	0·49	0·50	0·48	0·502
3	Carbon .	0·12	0·11	0·10	0·20	0·25	0·13	0·11	0·12	0·12	0·140
	Sulphur .	0·072	0·062	0·060	0·170	0·261	0·079	0·065	0·063	0·068	0·1000
	Phosphorus	0·033	0·031	0·034	0·058	0·082	0·039	0·036	0·033	0·034	0·0422
	Manganese	0·50	0·50	0·49	0·50	0·53	0·49	0·49	0·50	0·50	0·500
4	Carbon .	0·11	0·12	0·11	0·13	0·21	0·12	0·11	0·12	0·11	0·127
	Sulphur .	0·067	0·076	0·071	0·080	0·192	0·066	0·067	0·066	0·063	0·0842
	Phosphorus	0·032	0·037	0·036	0·037	0·065	0·034	0·035	0·035	0·032	0·0381
	Manganese	0·49	0·50	0·50	0·50	0·52	0·49	0·49	0·50	0·49	0·498
5	Carbon .	0·11	0·12	0·11	0·13	0·20	0·12	0·12	0·12	0·11	0·127
	Sulphur	0·062	0·078	0·072	0·074	0·178	0·066	0·073	0·075	0·065	0·0826
	Phosphorus	0·031	0·040	0·036	0·036	0·049	0·033	0·040	0·038	0·030	0·0370
	Manganese	0·50	0·51	0·50	0·50	0·52	0·50	0·50	0·49	0·50	0·502
6	Carbon .	0·11	0·12	0·11	0·12	0·15	0·12	0·12	0·12	0·10	0·119
	Sulphur .	0·060	0·079	0·075	0·065	0·098	0·069	0·060	0·081	0·055	0·0713
	Phosphorus	0·026	0·037	0·038	0·032	0·039	0·037	0·033	0·038	0·028	0·0341
	Manganese	0·50	0·50	0·50	0·49	0·51	0·49	0·49	0·50	0·49	0·497
7	Carbon .	0·10	0·12	0·10	0·12	0·12	0·11	0·11	0·12	0·11	0·112
	Sulphur .	0·056	0·079	0·066	0·064	0·061	0·064	0·062	0·082	0·062	0·0662
	Phosphorus	0·027	0·036	0·034	0·034	0·029	0·032	0·032	0·037	0·029	0·322
	Manganese	0·50	0·50	0·50	0·49	0·49	0·49	0·49	0·49	0·49	0·493
8	Carbon .	0·10	0·12	0·11	0·11	0·11	0·10	0·11	0·12	0·10	0·109
	Sulphur .	0·049	0·077	0·067	0·062	0·057	0·056	0·061	0·081	0·048	0·0620
	Phosphorus	0·025	0·035	0·034	0·031	0·030	0·029	0·033	0·038	0·030	0·0321
	Manganese	0·50	0·50	0·49	0·50	0·48	0·49	0·48	0·49	0·50	0·492
9	Carbon .	0·10	0·12	0·11	0·11	0·10	0·11	0·11	0·12	0·10	0·109
	Sulphur .	0·041	0·075	0·071	0·063	0·054	0·062	0·062	0·081	0·056	0·0628
	Phosphorus	0·022	0·036	0·032	0·030	0·029	0·033	0·031	0·037	0·025	0·0306
	Manganese	0·50	0·49	0·50	0·50	0·48	0·48	0·48	0·49	0·48	0·489
10	Carbon .	0·10	0·11	0·10	0·11	0·10	0·11	0·11	0·12	0·10	0·107
	Sulphur .	0·046	0·065	0·065	0·062	0·054	0·058	0·059	0·079	0·053	0·0601
	Phosphorus	0·020	0·035	0·031	0·029	0·028	0·032	0·029	0·041	0·027	0·0302
	Manganese	0·50	0·49	0·48	0·48	0·49	0·49	0·49	0·50	0·49	0·490
11	Carbon .	0·10	0·11	0·11	0·11	0·10	0·10	0·11	0·12	0·10	0·107
	Sulphur .	0·044	0·066	0·061	0·059	0·054	0·055	0·057	0·071	0·073	0·0600
	Phosphorus	0·022	0·034	0·029	0·031	0·029	0·031	0·029	0·036	0·031	0·0302
	Manganese	0·50	0·49	0·49	0·48	0·49	0·48	0·50	0·50	0·49	0·491
12	Carbon	0·09	0·10	0·09	0·10	0·10	0·11	0·10	0·10	0·09	0·098
	Sulphur	0·057	0·065	[illegible]	0·067	0·074	0·054	0·069	0·062	0·042	0·0597
	Phosphorus	0·022	0·036	0·030	0·030	0·031	0·033	0·033	0·057	0·022	0·0303
	Manganese	0·49	0·49	0·48	0·48	0·48	0·49	0·48	0·48	0·49	0·485

Average of the whole ingot: C, 0·117; S, 0·0720; P, 0·0339; Mn, 0·494

TABLE H.—*Ingot A. No Aluminium.*

	Centre.			Side.		
No.	Carbon.	Sulphur.	Phosphorus	Carbon	Sulphur	Phosphorus
1	0·28	0·037	0·029	0·29	0·042	0·036
2	0·60	0·143	0·119	0·36	0·052	0·049
3	0·54	0·125	0·094	0·31	0·053	0·038
4	0·37	0·076	0·056	0·34	0·063	0·054
			Ingot B. Aluminium.			
1	0·34	0·074	0·050	0·39	0·064	0·061
2	0·53	0·120	0·088	0·38	0·066	0·062
3	0·42	0·083	0·062	0·40	0·067	0·058
4	0·40	0·072	0·068	0·39	0·066	0·057

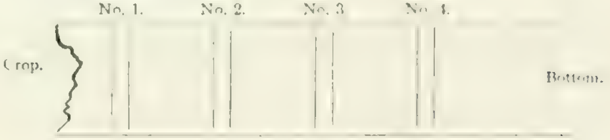


TABLE I.

	Centre.				Side.			
No.	Carbon.	Sulphur.	Phos.	Mn.	Carbon.	Sulphur	Phos	Mn.
1	0·54	0·053	0·038	0·61	0·53	0·054	0·035	0·60
2	0·58	0·078	0·036	0·63	0·49	0·051	0·034	0·60
3	0·71	0·135	0·065	0·57	0·54	0·056	0·035	0·64
4	0·55	0·058	0·036	0·64	0·54	0·058	0·034	0·63
5	0·53	0·064	0·036	0·64	0·52	0·062	0·036	0·63
6	0·52	0·064	0·034	0·60	0·51	0·062	0·036	0·61
7	0·51	0·068	0·041	0·59	0·51	0·062	0·038	0·60
8	0·53	0·057	0·035	0·62	0·52	0·059	0·039	0·62
9	0·51	0·062	0·039	0·62	0·51	0·064	0·040	0·61
10	0·52	0·069	0·039	0·61	0·53	0·066	0·039	0·63
11	0·52	0·054	0·035	0·61	0·53	0·056	0·036	0·63
12	0·52	0·049	0·036	0·61	0·50	0·044	0·040	0·59
Average .	0·545	0·0674	0·0391	0·620	0·518	0·0578	0·0368	0·616
Total average	0·531	0·0626	0·0379	0·618				
Ladle test .	0·50	0·062	0·040	[illegible]				

MR. R. TALBOT'S RESEARCHES ON SEGREGATION IN STEEL INGOTS.

BASIC OPEN HEARTH STEEL WITH ALUMINIUM.

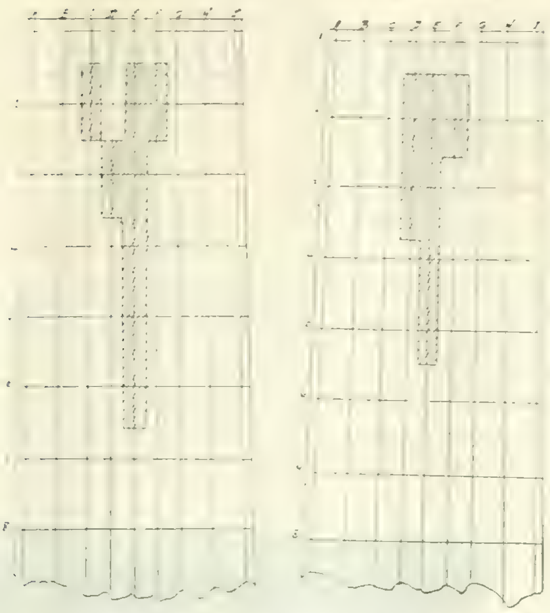


Fig. 4.—Showing Segregation [illegible] in the same heat [illegible]

longitudinally, in which the percentage of sulphur has increased more than 25 per cent. above the sulphur shown by the ladle test. In the case of the ingot to which no aluminium was added, the doubly shaded portion represents the area in which the percentage of sulphur has increased more than 75 per cent. over the sulphur shown by the ladle test; no such area appears in the ingot to which aluminium was added. It should be remembered that the drillings for analysis were taken at the points where the horizontal and vertical lines cross, and where the sulphur is above the limit; the area shaded has been taken half-way between such point and the nearest point where the sulphur falls below such limit.

No comparative tests were made in the case of basic steel with and without the addition of aluminium. As it became the established custom at the works always to add a small amount of aluminium to all ingots, the author at the time did not consider it important to have this done, considering that the influence of a small amount of aluminium in decreasing the area of segregation had been already sufficiently proved.

In order to prove the importance of leaving the ingot always in a perfectly upright position, until time has been given sufficient to allow the centre to solidify an ingot was taken immediately after being cast, and whilst its centre was still quite fluid, and inverted so that the base stood uppermost. After cooling in this position, the ingot was cut open, and analysed, with the results shown in Table E. As was to be expected, the most segregated portion was here found in the end which had been allowed to cool uppermost; that is, the broad end of the ingot, although this was the original bottom end. The ingot from the same cast, which was not inverted, has, of course, the segregated area in the normal position, as is shown by the analyses given in Table F

Another point to which attention should be drawn in the Tables E and F is that fairly high carbon basic steel, made from a phosphoric mixture, and in which the carbon has been raised from dead soft to about 0·5 per cent., the percentage desired is the regularity in the percentages of carbon, obtained by the addition of solid carbon to the steel whilst running into the ladle. Continental writers have several times lately questioned whether sufficient regularity can be obtained by this means, and the author would draw special attention to these analyses of carbon, as he considers they show the groundless nature of these statements. Tables I and K of the results obtained from billets from the same heat show also the same regularity in the carbon.

An examination of the foregoing results, shows clearly that by the use of aluminium a billet of a much more regular composition is obtained. This is especially important in the case of carbon, especially if this steel had without aluminium been intended for rail purposes, as the surface of the rail would probably have shown considerable irregularities in the carbon percentage, with a consequent want of uniformity in its wearing properties.

In cases in which the carbon has segregated to the centre, it is obvious that corresponding areas will be found at the sides in which the carbon is less than the mean, through the carbon having migrated to the centre to a greater or less extent. This will be seen clearly if reference is made to the analyses given in Tables C and D.

As in cases in which aluminium has been added the segregation is lessened, the distribution of the carbon over the surface of the ingot is found to be much more even, and to approach more nearly to the composition given by the ladle test.

To be continued.

[illegible]

ELECTRICAL EXHIBITION AT OLYMPIA.

(*Continued from page 597.*)

STURTEVANT ENGINEERING COMPANY, LTD.

There is a large selection of fans of various types manufactured by this Company. Two large electrically-driven Sturtevant "induced draught" fans command attention. These are similar to those supplied to the Sheffield Corporation Electricity Works, Neepsend, Sheffield, one of the most efficient stations in the Kingdom. A recent test of this plant showed a boiler efficiency of 85 per cent. when maintaining a rate of combustion equal to 60 lb. per hr. per square feet of grate surface.

The visitor will also notice the collection of electric propeller fans of an improved type. The four-pole motors fitted to these fans are entirely enclosed and of the highest grade.

There is an interesting novelty in the shape of an electrically-driven portable forge, which should prove a valuable addition to the repair outfits in central stations, etc. A Sturtevant organ blower is also shown coupled up to a few organ pipes, and illustrates how these special fans are applied to organ blowing. The organ in Westminster Abbey has for some years past been blown by one of these fans.

High pressure fans for cupola work and a good show of the company's well-known forge blowing and dust exhausting fans go to make up a very striking exhibit. Notice of this stand would be incomplete without referring to the well-known "Igranic" motor controlling apparatus. Very interesting examples of automatic starting gear for electrically-driven pumps, lifts, machine tools, printing presses, etc., are shown, also dynamo field regulators and starting and controlling rheostats for the most varied kinds of motor-driven machines.

GEIPEL AND LANGE.

One of the exhibits of this firm, which we illustrate (see fig. 1), is the Vulcan ohmmeter, and there are novel features in the design to which attention may be directed. It is arranged for portable duty and is fitted for measuring between the limits of ·1 ohm and 20 megohm. The proportions of the ohmmeter are so arranged that the readings are obtained directly from a scale and no calculation whatever is involved. The operation is as follows: The resistance to be measured is connected to terminals H H, the cursor S is then moved along a graduated bar until on pressing buttons A and B the galvanometer, which is suspended at E, and appears under the lens D, does not move, thus indicating the point of balance has been reached. The reading is now made from the scale corresponding with the position of the cursor, giving the exact resistance and ohms. Owing to the extremely wide range of resistance afforded with this set the same instrument is suited for workshop or for insulation testing; a compact set of cells is supplied in a uniform teak case, which is permanently fixed, as shown, to the underside of the ohmmeter. The whole equipment weighs 11 lb., and has dimensions of 18 in. by 5 in. by 4 in.

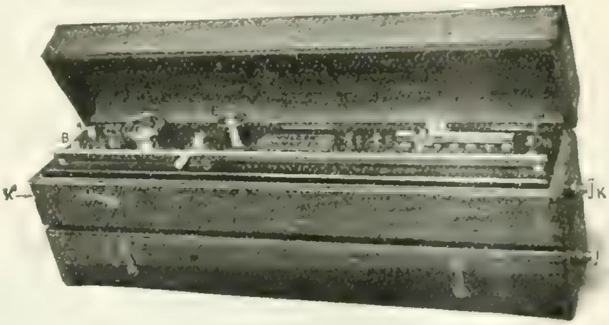


FIG. 1. VULCAN OHMMETER.

The proportions of Ohmmeter are so arranged that the readings are obtained directly from a scale.

The firm is also exhibiting lift controllers of various patterns, all controllers being connected up to a model electric lift arranged to illustrate the special features of each type of controller. Three of the chief patterns are the car switch type, arranged for operating the lift electrically from the car without the intervention of levers or ropes; a passenger type, and a standard goods lift type.

VICKERS, SONS, AND MAXIM, LTD.

The exhibit at this company's stand, which will probably attract chief attention, is the electrically-driven planing machine, controlled by the Vickers' patent beltless automatic reversing gear. The machine, which can be seen working at Olympia, should certainly be inspected. This type of planer is driven by a single motor, with a range of speed from about 300 to 900, the motor driving the machine through spur or worm gearing. On the cutting stroke the motor runs at its slowest speed, and at the end of the stroke, the length of which is easily adjusted to suit the work, the motor reverses automatically. As soon as the reversal has occurred a resistance is automatically inserted in the field winding, quickly raising the speed to 900 for the return stroke. At the end of the quick return stroke immediately before reversal, the field resistance is short-circuited, providing a strong field for reversing in, and the motor reverses and makes its slow cutting stroke. The special switches for this control are illustrated in fig. 4. The function of these switches are (*a*) to start the motor after it has come to rest at the end of the stroke ; (*b*) to insert or withdraw resistance in series with the field coils, thus altering the speed after reversal ; (*c*) to reverse the armature connections, and thus reverse the direction of rotation ; (*d*) to retard the armature at the end of the stroke by strengthening its field prior to reversal. It should be particularly noted that the speed variation of the motor is produced entirely by varying the shunt current, and the efficiency of the motor is not less than 87 per cent. under any circumstances.

By this system of motor driving several objectionable features are removed. There are no driving pulleys to reverse and the inertia of the driving system is much reduced, permitting quick reversal without the excessive waste of energy shown by a power diagram of the usual type of belt machines. Again, there are no belts to wear, an important economy being thus effected. The speed of cutting, too, can be instantly varied between the limits of the slowest cut and of the quick return. This feature at once makes the planing machine of far greater value than it has been hitherto. The cutting speed can be instantly suited to the material from the hardest steel to softest steel, and wrought iron, thus increasing the general output of the machine. The reversal is more positive and quicker than that obtained by belt driving and there is no loss of time at reversal such as is often seen with a belt which has become slack or worn. Power diagrams making comparison between ordinary belt driven planer and planer on this system are given in fig. 2 and fig. 3.

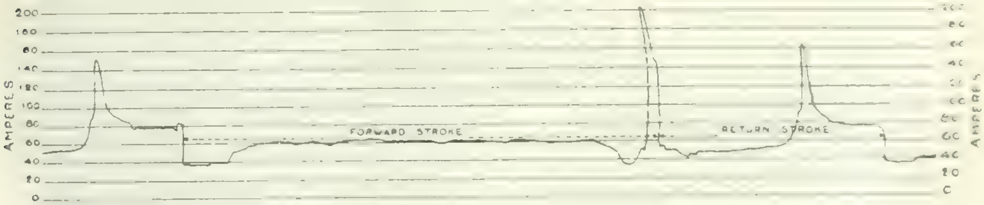


Fig. 2. Test made on Niles' Planer No. 106, size 10 ft. by 12 ft. by 25 ft. Belt driven in the usual manner by a 40-h.p. Constant Speed Motor. Travel of tool, 16 ft. 6 in. ; average rate of cutting, 13 ft. 4 in. per minute ; average rate of return stroke, 27 ft. 6 in. per minute.

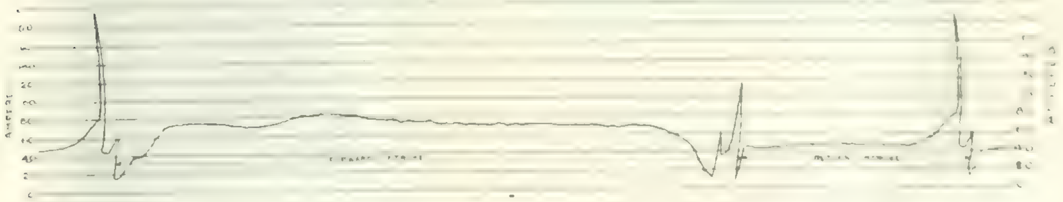


Fig. 3. Test made on Sharp Stewart Heavy Planer No. [illegible], size 12 ft. by 12 ft. by [illegible], driven by a Vickers' 20-h.p. Variable Speed Motor, in conjunction with Vickers' Patent Automatic Reversing Gear. Revolutions on cutting stroke, 370 per minute ; revolutions on return stroke, 1,000 per minute ; travel of tool 26 ft. 6 in. ; average rate of cutting, [illegible] in. per [illegible] ; average rate of return stroke, 41 ft. per minute.

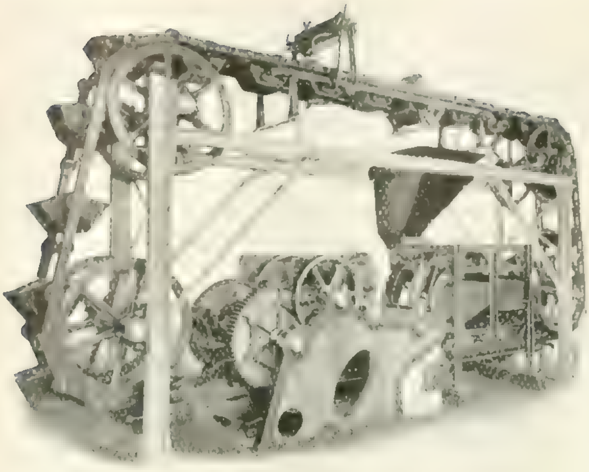


FIG. 5. BABCOCK AND WILCOX CONVEYOR
The driving device is the important feature.

BABCOCK AND WILCOX

We illustrate in fig. 5 the Babcock and Wilcox conveyor. This conveyor differs from the ordinary chain conveyors in many particulars. While it is usually called a conveyor and classed with this machinery, it is, in fact, a series of cars linked together, each having a body hung on pivots, gravity keeping them in an upright position, no matter whether the track is horizontal, vertical, or inclined.

The driving device is an important feature. The driver may be actuated by any motive power obtainable, and consists of a spur-geared engine operating two sets of pawls, which successively thrust the chain in the direction of its travel, engaging with both sides simultaneously. By this device any wear in the chain links is compensated.

Another point to which attention may be directed is the application of free or revolving curves where the direction of the conveyor is changed, either from the horizontall to the vertical in the same plane, or at any angle to the first plane of motion. In descending from an upper run to any depth the maximum stress is at the point of turning to descend, and here the wheels carrying the chain and buckets cease to rotate as soon as they touch the revolving free-wheels, and when movement ceases, friction also ceases, and, consequently, wear on the chain, wheels and axles.

A conveyor is shown in motion at Olympia. It is fitted with special compensating pawl driver, with direct-geared electric motor.

There is also shown a model of patent water-tube boiler, a model of a mechanical chain grate stoker for burning low grade fuels smokelessly and a model of water-softening and purifying plant.

Additional exhibits are the turbine tube cleaner, for removing the incrustation which forms inside boiler economiser or other tubes and specimens of wrought steel steam piping.

DRAKE AND GORHAM LTD.

This company is showing applications of the electrical driving of machinery, including three-throw pump, cream separator churn, chaff cutter, horse clippers, etc. The cream separator is started by means of a Holden magnetic clutch, which affects a large saving in power transmission, and has been extensively adopted at the Woolwich Arsenal and elsewhere. This stand will be lighted by means of the well-known Jandus lamps, for which this company are sole agents. On another stand there is shown a gas-producer set, together with gas engine and direct-coupled dynamo, and standard switchboard mounted on white marble. The firm is also exhibiting incandescent fittings, Nernst lamps, Tantalum lamps, heating apparatus, etc.

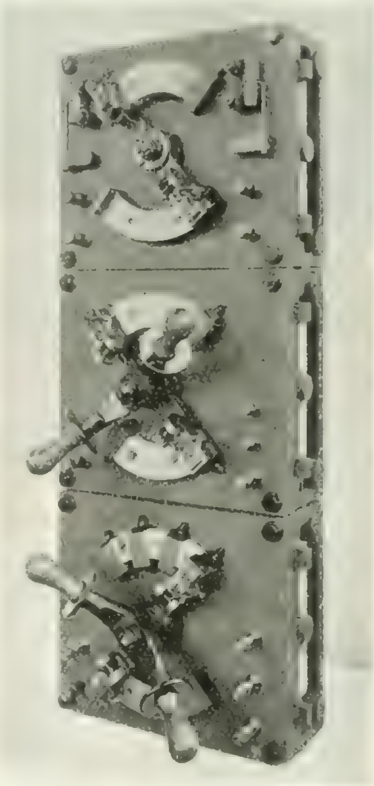
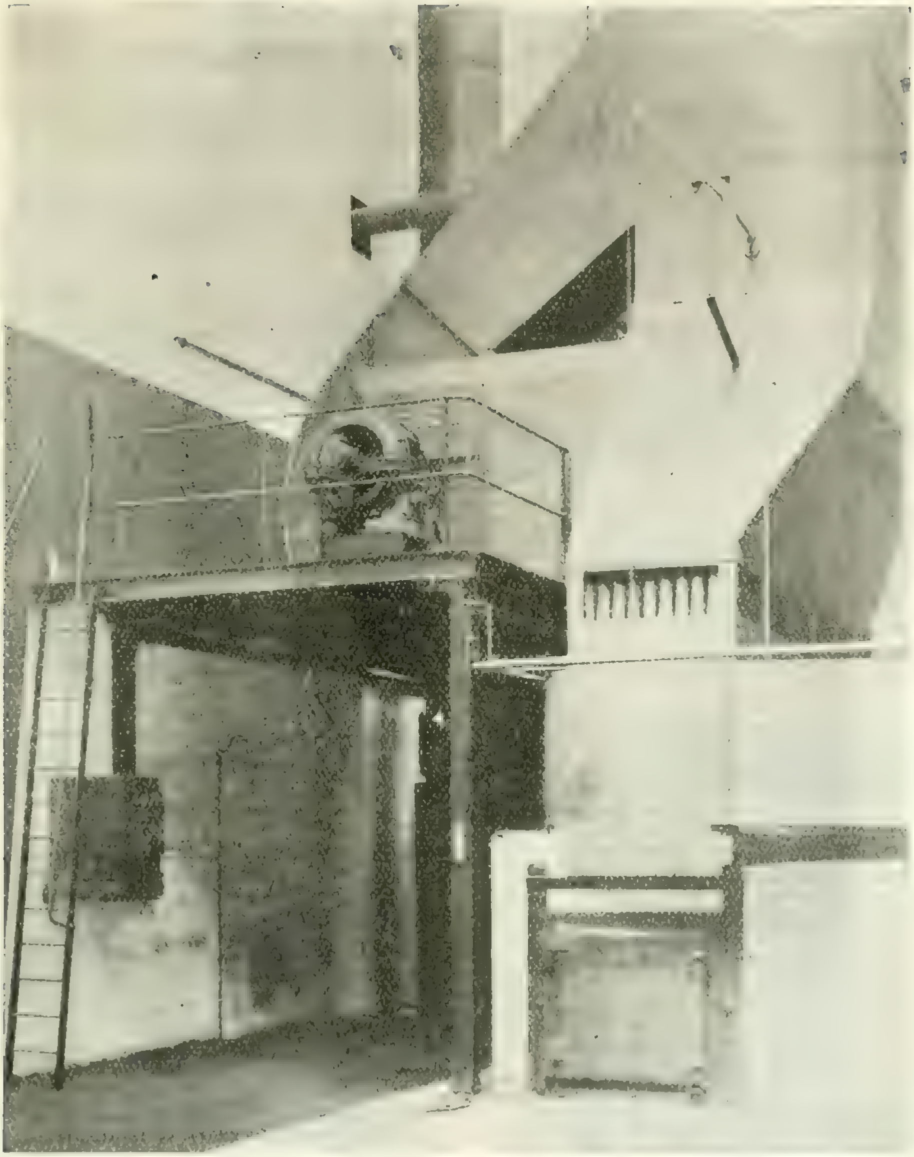


FIG. 4. SWITCHES FOR CONTROLLING ELECTRICAL PLANING MACHINE BY VICKERS' PATENT SYSTEM.



STURTEVANT "INDUCED" DRAUGHT FAN, DRIVEN BY DIRECT-COUPLED ELECTRIC MOTOR, AT THE ELECTRICAL POWER STATION, SHEFFIELD.

A recent test of this plant showed a boiler efficiency of 85 per cent. when [illegible] a rate of combustion equal to 65 lb. [illegible] per square foot of grate area.

CONTRACTORS' NEWS.

We shall be pleased to insert under this column, free of charge, particulars of open contracts.

CONTRACTS OPEN.

Last Day

Pontypridd.—For the Pontypridd Urban District Council: (Section B) overhead equipment for tramways, (C) cables for ditto. Mr. Reginald P. Wilson, 66, Victoria Street, Westminster Sept. 30

Westerham (Kent). — Providing and fixing a steam engine with lift and force pumps (capable of delivering 500,000 gallons of water in 24 hours) on land at the Hill Park Estate, Westerham, Kent, for the Metropolitan Water Board. District Engineer, Brookmill Road, Deptford, S.E. ... ... Oct. 2

Clay Cross (near Chesterfield).—Supplying and laying of about 860 yards of 4in. cast-iron pipes and the construction of aerating weir, two filter beds, and appurtenant works for their water supply, for the Clay Cross Urban District Council. Mr. W. H. Radford, C.E., Albion Chambers, King Street, Nottingham . Oct. 2

London.—Boilers and boiler-house plant, new laundry machinery, and revisions to laundry plant, also new steam main, etc., at the Eastern Hospital, Homerton, N.E., for the Metropolitan Asylums Board. Offices of the Board, Embankment, E.C. Oct. 3

London, S.W.—Manufacture and laying of (a) 56 miles low-tension lead-covered, paper-insulated cables, 20 miles dry-core telephone cables, cast-iron feeder pillars, etc.; (b) 24 miles extra high-tension three-core, lead-covered, paper-insulated cables, etc., for the London County Council, County Hall, Spring Gardens, S.W. . Oct. 3

Southgate.—Work and materials required in the construction of the permanent way (for electric traction), bridge work, road widenings, etc., for Contract No. 14; railway No. 2 to be laid along Bounds Green Road, Wood Green, and High Road, Southgate, for the Light Railways and Tramways Committee of the Middlesex County Council. Mr. H. T. Wakelaw, Middlesex Guildhall, Westminster, S.W.... ... ... Oct. 4

Lanark.—Supplying and laying, within the Lesmahagow special water supply district about nine miles of cast iron pipes, varying from 1½ in. to 5 in. in diameter with other relative work, for the Upper Ward, District Committee of the County Council of Lanark. Messrs. Warren and Stuart, civil engineer, 94, Hope Street, Glasgow. Oct. 7

Last Day

Watford.—Drainage and sewerage works at Cassio Bridge, for the Watford Urban District Council. Mr. David Waterhouse, Surveyor to the Council, Watford ... Oct. 4

London.—Works in connection with the partial reconstruction of bridges carrying Clerkenwell Road over Metropolitan Railway; Commercial Street East, over Great Eastern Railway; East India Dock Road over North London Railway; and High Street, Kingsland, over North London Railway (docks line); and the reconstruction of bridge carrying Denmark Hill over the London, Brighton, and South Coast Railway for the London County Council. Mr. Maurice Fitzmaurice, Spring Gardens, S.W. ... ... Oct. 10

Manchester. — Supply, delivery, and erection of a steel roof, girders, stanchions and sundry ironwork for a boiler-house at the Rochdale Road Gasworks, Manchester, for the Gas Committee. Mr. C. Nickson, superintendent, Gas Department ... ... Oct. 14

Bournemouth.—Construction of two passenger lifts on the East and West Cliffs, Bournemouth, for the Bournemouth Town Council. Borough Engineer ... ... Oct. 16

Horsforth (near Leeds).—Construction and erection of a suction gas-producing plant and gas-engine capable of producing 32 b.h.p. for the purpose of driving a bore-hole pump for the Horsforth waterworks, at Scotland Lane, Horsforth, for the Urban District Council. Mr. E. J. Silcock, 10, Park Row, Leeds... ... ... Oct. 16

COMING CONTRACTS.

Nailsworth.—The Council have applied to the Local Government Board for approval to the borrowing of £15,000 for purposes of sewerage and sewage disposal.

Reigate. — An inquiry has been held by Colonel A. G. Durnford, R.E., into an application of the Town Council for sanction to borrow a further loan of £4,000 for purposes of electric lighting.

Chadderton.—Mr. H. Percy Boulnois, of the Local Government Board, has held an inquiry into an application of the Urban District Council for sanction to amend a proposed scheme of sewerage and sewage disposal for Middleton Junction, Chadderson Fold, and Mills Hill, and to borrow a further sum of £4,600 in respect of the amended proposals.

Alnwick.—Mr. R. H. Bicknell, has held a Local Government Board inquiry into the application of the Council for sanction to borrow £6,850 for purposes of sewerage and sewage disposal.

CONTRACTS CLOSED.

South America.—Messrs. Thomas Piggott and Co., pipe, tank, and structural makers, have secured an order for seventeen of their patent stamped steel tanks for South America.

Manchester.—The Unbreakable Pulley and Mill Gearing Company, Ltd., have secured the contract for the complete equipment of the new mill of the Radcliffe Room and Power Company, Ltd., Radcliffe, Manchester, with "Unbreakable" pulleys, swivel bearing, couplings, and turned Siemens-Martin steel shafting.

Timperley.—Messrs. Meldrum Bros. Ltd., of Timperley, have received an order from Messrs. Babcock and Wilcox, Ltd., for one of their well-known mechanical stokers to consume a mixture of slack and locomotive smoke-box refuse, under a large Babcock boiler, to be installed at Gateshead-on-Tyne for the North-Eastern Railway Company. The order followed a practical test of the stoker when burning the material at another installation.

Doncaster.—Messrs. Barber, Walker, of Nottingham, have placed a contract with Mr. P. J. Mitchell, of 52, Queen Victoria Street, E.C., for the generating plant required at their new Bentley Pit, near Doncaster. This contract consists of complete central station, consisting of two 500-kilowatt low-pressure turbines, together with the necessary three-phase alternators, exciters, motor generators, switchboard cables, condensing plant and cooling tower; also for two high-lift Rateau centrifugal pumps capable of delivering 2,000 gallons of water per minute to a head of 600 ft.

Selby.—Messrs. James Watt and Co. have received from the Selby Urban District Council an order for duplicate pumping machinery, consisting of one pair of triple-expansion engines, bore-hole pumps, force pumps, boilers, and accessories.

Dumbarton.—The Corporation of Dumbarton have placed an order with Ed. Benniss and Co., Ltd., Little Hulton, Bolton, for two of this firm's improved smokeless chain-grate Miller-Bennett stokers, complete with shafting and accessories.

Camberwell.—The Guardians have placed their orders for electrical fittings during the forthcoming twelve months with the following firms: Bell's Asbestos Company, Ltd.; General Electric Company, Ltd.; Reed's Electrical and Engineering Supply Company, Ltd.; and H. W. Willcox and Co.

Croydon.—The Corporation have accepted the tender of Messrs. T. Harding Churton and Co. for the supply of single-phase induction motors and centrifugal pumps.

Neath.—The Council have placed contracts in connection with the electric lighting undertaking with Callender's Cable and Construction Co., at £8,449 17s., and Messrs. Johnson and Phillips, at £6,335 17s. [illegible]d.

APPOINTMENTS VACANT.

New Zealand.—Wellington, New Zealand, Technical Education Board requires an instructor in engineering. Salary £300, with £40 passage allowance. The High Commissioner for New Zealand, 13, Victoria Street, London, S.W. ... ... —

Cork.—An assistant head master is wanted immediately for Crawford Municipal Technical Institute, Cork. Salary £200. Mr. E. A. O'Keeffe, at the Institute —

Newcastle.—Applications are invited for the position of principal of Rutherford College, Newcastle-on-Tyne. Salary £400, rising to £600 ... ... Sept. 30

Wandsworth.—An assistant master is required at Wandsworth Technical Institute for physics and chemistry. Commencing salary £150. The Registrar ... —

Edinburgh.—The Corporation invite applications for the post of assistant engineer, to act as station superintendent at one of their electric generating stations. Commencing salary £180, rising by annual increments to £270 per annum. Mr. F. A. Newington, Dewar Place, Edinburgh Oct. [illegible]

Clerkenwell.—The Governing Body of Northampton Institute, Clerkenwell, London, E.C., invite applications for the appointment of instructor in mathematics in the engineering day courses. Salary £120 per session (October to July). Dr. R. Mullineux Walmsley —

APPOINTMENTS FILLED.

Burnley.—The Electricity Committee has appointed Mr. Jas. E. Starkie, first assistant engineer at the electricity works, as borough electrical engineer, at a salary of £250 per annum, rising to £300 a year hence.

Bournemouth.—Mr. H. G. Andrews has been appointed assistant to Mr. J. Bulfin, borough electrical engineer of Bournemouth.

Greenock.—The Corporation has appointed Mr. W. A. Toppin as superintendent of the meter and installation department, at a salary of £130 per annum.

Bolton.—Mr. P. A. Locke, senior chargeman at Plymouth Corporation electricity works, has been appointed chief lecturer in electricity under the Education Authority of Bolton, Lancs.

London.—Mr. James [illegible], has been appointed lecturer to the evening classes in electrical engineering at the Battersea Polytechnic.

Handsworth.—Mr. T. W. Green, of Wolverhampton, has secured the appointment of assistant engineer to the electric supply department of the Handsworth Urban Council.

Leeds.—Mr. W. T. Lancashire, deputy city engineer of Sheffield, [illegible] city engineer of Leeds, at a salary of £600 a year.

Share List of Engineering, Electrical, Iron and Steel, and other Companies.

The following is a comprehensive list of Companies in the industries covered by "Page's Weekly," in which shares business is being currently transacted. Additions will be made from time to time as occasion requires. We desire it to be understood that while our Share List will generally be found correct, we do not hold ourselves responsible for any loss or inconvenience that may arise from possible inaccuracies

Stock Exchange Settling Days.—Settling days on the Stock Exchange are as follows:—
Consols: Oct. 4th. General Settlements: October 13th, 27th. Bank Rate, September 7th, 1905, 3 per cent.

I. ENGINEERING, IRON, AND STEEL COMPANIES.

Present Amount Subscribed	Shares	Last Dividend	Name	Paid up	Closing Prices
11,[illegible]70	5	5%	Alldays & Onions Pneumatic Engineering, Ltd.	3	2⅛—2⅜
10,000	5	3/	Do. Cum. Pref. 6 per cent.	5	4½—5
3,210,000	1	1/-	Armstrong (Sir W. G.), Whitworth and Co., Ltd.	1	3 5/16 3 [illegible]
76,970	5	2/-	Do. 4% Cum. Pref.	5	5¼—5½
1,500,000	100	4%	Do. 4% 1st Mort. Dbs. Rd.	100	103—105
£100,000	100	4½%	Aveling and Porter, Ltd., 4½% Reg. Mt. Debs. Red.	100	96—99
530,000	1	2/4½	Babcock and Wilcox, Ltd., Ord.	1	3½—3¾
100,000	1	7½d.	Do. 6% Cum. Pref.	1	1 1/16—1⅛
20,000	5	8/-	Baker (Joseph) and Sons, Ltd., 6% Cum. Pref.	5	4¾—5¼
250,000	1	6½d.	Baldwins, Ltd., 5½% Cum. Pref.	1	1—1⅛
£250,000	Stk	4½%	Do. 1st Mt. 4½% Deb. Stk. Red.	100	102—104
150,000	4½	2/8½	Barrow Hæmatite Steel Co., Ld., O.	4½	1½—1⅝
50,000	4½	3	Do. do. Cum 2nd. Pref.	4½	4½—4¾
3[illegible],[illegible]34	5	2/6	Bayliss, Jones and Bayliss, Ltd., 5% Cum. Pref. Shares	5	4¾—5¼
£500,000	100	4½%	Beardmore (Wm.) & Co., Ltd. 4½% 1st Mt. Debs., Red., Scrip 50% pd	—	104½—106½
50,000	10	6/-	Bell Brothers, Ltd., 6% Cum. Pref.	10	11¾—12¼
£[illegible]	Stk	4%	Do 4% Deb. Stock, Red.	100	100—102
200,000	1	1/-	Beyer, Peacock and Co., Ltd., Ord.	1	[illegible]
300,000	1	6½d.	Do. 5½% Cum Pref.	1	[illegible]
£300,000	Stk	4½%	Do. 4¼% Red. Deb. Stock	100	93—96
1,629,760	1	6d.	Bolckow, Vaughan and Co., Ltd., O. Nos. 1-1,629,760	1	[illegible]—1[illegible]*
1,860,900	1	3½d.	Do. Nos. 1,639,101-3,500,000	12/-	[illegible]
1,160,000	1	10½d.	Brown (John) and Co., Lim., Ord., Nos. 1-1,160,000	15/-	1⅝ 1¾
590,000	1	1/2	Do. Ord., Nos. 1,160,001-1,750,000	1	[illegible]
71,000	10	5/-	Do. 5% Cum. Pref.	10	11½ 11⅞
154,500	5	5/-	Cammell, Laird & Co., Ltd., Ord	5	9¾—10
232,500	5	2/6	Do. 5% Cum. Pref.	5	[illegible]
450,000	1	1/2½	Clayton & Shuttleworth, Ltd., Ord.	1	[illegible]
70,000	5	2/6	Do. 5% Cum. Pref.	5	[illegible]—5½
£[illegible]	Stk	4%	Do 4% 1st Mort. Db. Stk. Red	100	100—102
100,000	10	30/-	Consett Iron Co., Ltd., Ord.	7½	32½ 33½
57,031	10	10/-	Crossley, Bros., Ld., Ord. 40340/97370	10	15[illegible] 15¼
[illegible]	10	5%	Do 5% Cum Pref.	10	11[illegible] 11[illegible]
[illegible]	1	2/6	Delta Metal, Ltd. Shares	1	2½ [illegible]
1,2[illegible]	1	3½d.	Dorman, Long & Co., Ltd.	1	[illegible]
£400,000	Stk	4%	Do. 4% 1st Mort. Perp. Deb. Stk.	100	90—94
200,000	5	3/-	Dunderland Iron Ore Co., Ltd., 6% Cum. Pref. and Participating	5	3¼ 3¾
250,000	1	9d.	Dunlop (James) & Co., Ltd., Ord.	1	[illegible]
300,000	1	7½d	Do. 6% Cum. Pref.	1	⅞—1
4,721	13	13	Ebbw Vale Steel, Iron & Coal Co., Ltd.	13	8½—9½
[illegible]	13	10/-	Do. do. do.	10	7½ 8
[illegible]	10	8/-	Elliott's Metal, Ltd.	8	7¼—7¾
[illegible]	10	5%	Do. Cum. Pref. 5%	10	8¾—9¼
1[illegible]6,74[illegible]	Stk	4	Do. Deb. 4%	100	90 94
25,000	10	6/-	Fairfield Shipbuilding & Engng. Co., Ltd., 6% Cum. Pref.	10	11¼—11¾
£2[illegible]	Stk	4½	Do. 4½% Mort. Deb. Stk. Red.	100	100—103
9,000	10	10%	Fleming & Ferguson, Ltd. Ord. Nos. 1/9000	10⅛	12¼ 12¾
6,000	10	5%	Do. 5% Cum. Pref. Nos. 9001/15000	10	9½ 10½
126,000	3	3/-	Fraser & Chalmers, Ltd., Ord.	3	3¾ 4¼
21,000	3	1/6	Do. 7½% Cum. Pref.	3	5½—6
10,000	10	[illegible]	Galloways, Ltd., 5% Cum. Pref. 18001/28000	10	6½—7½
£150,000	Stk	4	Do 4% 1st Mort Deb Red	100	88½ 89½
1[illegible],800	10	16	Greenwood & Batley, Ltd., Ord.	10	6¾ 7¾
9,600	10	7%	Do. 7% Cum. Pref.	10	10—10½
965,000	1	1/-	Guest, Keen & Nettlefolds, Ltd. Ord.	1	2[illegible] 2[illegible]
[illegible]11,000	5	2/6	Do. 5% Cum. Pref.	5	6—6¼
£1,850,500	Stk	4%	Do. 4% Irred. Mort. Deb. Stk	100	105—107
13,000	5	2/6	Gwynnes, Ltd., 5% Cum. Pref.	5	2—3
250,000	1	1/-	Hadfield's Steel F'dry Co., Ld., Ord.	1	3⅜—3⅝
20,000	10	4/6	Do. 4½% Cum. Pref.	10	10½—11
30,000	5	3/-	Hall (J. & E.), Ltd. 6% Cum. Pref.	5	5—5½
408,505	1	1/6	Harvey United Steel Co., Ltd.	1	[illegible]
47,500	10	7½%	Hawthorn, Leslie & Co., Ltd. Ord.	10	[illegible]
28,001	5	7/-	Head, Wrightson & Co., Ltd.	5	5—5½
[illegible]	1	7½d.	Hill (Richard) & Co. (1899) Ld., Ord.	1	[illegible]
18,000	5	3/	Do. 6% Cum. Pref.	5	4[illegible]—5½
£100,000	Stk	6	Hornsby (Richard) & Sons, Ltd., Ord. 6% Cum. Pref.	100	98—100

ENGINEERING, IRON, AND STEEL COMPANIES—Cont'd.

Present Amount Subscribed	Shares	Last Dividend	Name	Paid up	Closing Prices
750,000	1	7½%	Howard & Bullough, Ltd., Ord.	1	1½ [illegible]
25,000	10	6/-	Do. 6% Pref. (Non-Cum.)	10	12½ 13
£250,000	Stk	4%	Do. 4% Deb. Stk., Red. after 1905	100	[illegible]
37,500	10	20	Kynoch, Ltd.	10	17—17½
49,587	10	5%	Do. Cum. Pref. 5%	10	10[illegible] 10[illegible]
300,000	1	4½d	Lambert Bros., Ltd., Ord.	1	⅝—⅞
50,000	5	2/9	Do. 5½% Cum. Pref.	5	4—4½
40,000	3	2/1½	Leeds Forge Co., 7% Cum. Pref.	3	3[illegible] [illegible]
200,000	1	7½d.	Lysaght (John), Ltd., 6% Cum. Pf.	1	[illegible]
£300,000	Stk	4½%	Do. 4½% 1st Mt. Deb. Stk., Red.	100	108—110
40,000	10	5/-	Mather & Platt, Ld., 5% Cum. Pref	10	11½ 11[illegible]
210,000	1	8½d.	Measures Bros., Ltd., Ord.	1	½ [illegible]
75,000	1	6½d.	Do. 5½% Cum. Pref.	1	¾ [illegible]
£75,000	Stk	4½%	Do. 4½% 1st Mt. Db. Stk., Red	100	93 [illegible]
21,943	5	2/6	Muntz Metal, Ltd.	5	[illegible]
14,248	5	5%	Do. Pref. 5%	5	4½ [illegible]
5,000	62½	47/6	Nantyglo and Blaina Iron Works, Ltd., 8% Cum. Pref.	62½	71 [illegible]
73,000	10	5/-	N. Brit. Loco. Co., Ltd., 5% Cm. Pf.	10	12[illegible] 1[illegible]
60,000	5		North-Eastern Steel Co., Ltd.,		
£250,000	Stk	4½%	4½% 1st Mrt. Db. Stk., Red.	100	[illegible]
122,000	5	1/6	Pearson & Knowles Coal and Iron Co., Ltd., Ord., "B"	5	4[illegible] [illegible]
50,000	5	3/-	Do. 6% Cum. Pref. "A"	5	6[illegible] [illegible]
70,000	10	10/-	Pease & Partners, Ltd., Ord.	10	11½—12
£400,000	Stk	4%	Do. 4% Perp. Deb. Stock	100	100—103
20,000	5	3/-	Peebles (Bruce) & Co., Ld., 6% Cm. P.	5	4½ [illegible]
65,000	1		Pooley (Henry) & Son., Ltd., Ord	1	10/6—11/6
13,000	5	—	Do. 5½% Cum. Pref.	5	4½ [illegible]
230,000	1	—	Projectile Co. (1902), Ltd., Ord.	1	[illegible]
126,938	5	2/-	Rhymney Iron Co., Ltd.	5	1½ [illegible]
73,062	5	2/-	Do. New	5	1[illegible]
£330,000	—	5%	Do. 5% Mort. Deb., Red.	100	99—101
350,000	1	7½d.	Richardsons, Westgarth & Co., Ltd., Ord. 350,001—700,000	1	
£350,000	1	7½	Do. 6% Cum. Pref.	1	[illegible]
£350,000	Stk	4½	Do 4½% Perp. Deb. Stock	100	96 [illegible]
35,000	10	12/-	Ruston, Proctor & Co., Ltd.	10	16[illegible]
275,000	1	6d.	Scott (Walter) Ltd., Ord.	1	[illegible]
300,000	1	7½d.	Do. 6% Cum. Pref.	1	⅞—1
£300,000	Stk	4%	Do. 4% Perp. Deb. Stk.	100	[illegible]
£115,300	100	5%	Shelton Iron, Steel and Coal Co., Ld. 1st Charge 5% Debs., Red	100	[illegible]
£97,900	100	6%	Do. 6% 2nd Mort. Debs., Red.	100	[illegible]
250,000	1	1/-	South Durham Steel & Iron, Ltd. Or.	1	[illegible]
300,000	1	1/2½	Do. 6% Cum. Pref.	1	[illegible]
£300,000	Stk	4½%	Do. 4½% Per. Deb. Stock	100	[illegible]
49,560	10	2½%	Steel Co. of Scotland Ord. 1/49560	[illegible]	7—7½
£125,240	Stk	5%	Do. 5% Trust Mort. Deb	100	10[illegible]
25,000	10		Stephenson (Robert) & Co., Ltd., Or.	10	[illegible]
25,000	10	5/6	Do. 5½% Cum. Pref.	10	[illegible]
£250,000	Stk	4%	Do. 4% Perp. Deb. Stock	100	77 [illegible]
85,000	10	9/-	Stewarts & Lloyds, Ltd., Ord.	10	[illegible]
55,000	10	6/-	Do. 6% Cum. Pref.	10	14[illegible]
634,732	1	6d.	Swan, Hunter & Wigham-Richardson, Lim. Ord.	1	[illegible]
538,845	1	6d.	Do. 5% Cum. Pref	1	[illegible]
£240,000	Stk	4½%	Do. 4½% 1st Mort. Deb. Stk. Red	100	96 [illegible]
300,000	1	6d.	Thames Iron Works, Shipbuilding & Engineering Co., Ltd., 5% Cum. Pf.	1	[illegible]
£200,000	100	4%	Do. 4% Irredeem. 1st Mort. Deb.	100	[illegible]
£148,700	1	7½d.	Thornycroft (John I.) & Co., Ltd. Or.	1	[illegible]
£160,000	1	7½d.	Do. do. 6% Cum. Pref.	1	[illegible]—1[illegible]
10,000	10	5/-	Tylor (J.) & Sons, Ltd. 5% Cum. Pf.	10	9½ [illegible]
$508495200	$100	$½	United States Steel Corp. Com. Stk.	$100	3[illegible]
$360314100	$100	$1¾	Do. 7% Cum. Pref. Stock	$100	107[illegible]
$162268000	$1000	5%	Do. 10-60 yr. 5% Sk. Fd. G. Bd	$1000	101—103
3,350,000	1	1/-	Vickers, Sons & Maxim, Ltd. Ord.	1	[illegible]
750,000	1	6d.	Do. 5% Non-Cum. Pref.	1	[illegible]
£750,000	Stk	5%	Do. 5% Non-Cum. Pref. Stock.	100	120—123
£1,250,000	Stk	4%	Do. 4% 1st. Mort. Deb. Stk. Red.	100	104—106
£1,000,000	100	4½%	Do. 4½% 2nd Mort. Debs., Red.	100	105—107
225,000	1	1/2½	Weardale Steel, Coal & Coke, Ltd., Def. Ord.	1	⅞—1
500,000	1	7½d	Do. 6% Cum. Pref. Ord.	1	[illegible] 1 1/16
£300,000	Stk	4%	Do. 4% Perpetual Deb. Stock	100	85 [illegible]
7,637	5	2/9	Weldless Steel Tube, Ltd., Cum. Pref. 5½	5	4½ 4[illegible]
300	Stk	4½%	Do. Mort. Deb. 4½%	100	92—9[illegible]
66,666	5	3/-	Willans & Robinson, Ord.	5	½—1½
66,666	5	3/-	Do. 6% Cum. Pref.	5	1½—2½
£246,641	Stk	4%	Do. 4% 1st Mort. Deb. Stk. Red	100	74—7[illegible]
£150,000	Stk	4½%	Yorkshire Iron & Coal Co., Ltd., 4½% 1st Mort. Deb. Stk. Red.	100	74—76

Stocks and Shares marked * are quoted ex-dividend.

II.—ELECTRICAL MANUFACTURING COMPANIES.

Present Amount Subscribed	Shares	Last Dividend	Name	Paid up	Closing Prices
70,000	1	6d.	Alliance Elec. Co., Ltd. 5% Cum. Pf.	1	[illegible]
125,000	1	7½d.	Aron Elec. Meter Ltd., 6% Cum. Pf.	1	[illegible]
120,000	1	1/2½	Bell's Asbestos Co., Ltd. ..	1	1[illegible]—1
100,000	5	4/-	British Insulated & Helsby Cables Ltd., Ord.	5	[illegible]
100,000	5	3/-	Do. 6% Cum. Pref. ..	5	[illegible]
£500,000	Stk	4½%	Do. 4½% 1st Mort. Deb. Stk. Red.	100	103—106
£200,000	Stk	4½%	British Thomson-Houston Co., Ltd., 4½% 1st Mort. Deb. Stk. Red. ..	100	99—101
400,000	5	3/-	British Westinghouse Electric and Manufac. Co., Ltd., 6% Pref. .	5	[illegible]
£616,353	Stk	4%	Do. 4% Mort. Deb. Stk. Red...	100	[illegible]
105,731	2	2/-	Brush Elec. Enging. Co., Ltd., Ord..	2	[illegible]
150,000	2	2/4[illegible]	Do. 6% Pref. ..	2	[illegible]
£125,000	Stk	4½%	Do. 4½% Perp 1st Deb. Stk..	100	91—94
£125,000	Stk	4½%	Do. 4½% Perp. 2nd Deb. Stk.	100	78—81
35,000	5	7/6	Callender's Cable & Constn. Ltd. Ord.	5	10—11
40,000	5	2/6	Do. 5% Cum. Pref. ..	5	[illegible]
£200,000	Stk	4%	Do. 4½ 1st Mort. Deb Stk. Red.	100	109—111
85,000	3	1/6	Crompton & Co., Ltd...	3	[illegible]
£100,000	—	5%	Do. 5% 1st Mort. Reg Debs	100	95—100
52,000	5	10/-	Dick, Kerr & Co., Ltd., Ord. ..	5	[illegible]
61,000	5	3/-	Do. 6% Cum. Pref.	5	[illegible]
£300 000	Stk	4½%	Do. 4½ Deb. Stock, Red.	100	105—107
233,334	1	6d.	Doulton & Co., Ltd., 5% Cum. Pref.	1	1½—1[illegible]
£233,334	Stk	4%	Do. 1st Mort. 4% Iree. Deb. Stk.	100	106—10[illegible]
99,261	5	1/6	Edison and Swan United Electric Light, Ltd., "A" Shares Nos. 1-99,261	3	1½—1¾
17,139	5	2/6	Do. "A" Shares Nos [illegible]	5	2—2¼
£344,023	Stk	4%	Do. 4% Deb. Stock Red.	100	[illegible]
£100,000	Stk	5%	Do. 5% Second Deb. Stk. Red.	100	[illegible]—91
112,100	2	1/7½	Electric Construction Co., Ltd. ..	2	[illegible]
31,390	2	2/9[illegible]	Do. 7% Cumulative Pref.	2	[illegible]
£200,000	Stk	4%	Do. 4% Perp. 1st Mt. Deb. Stk	100	92—[illegible]
10,248	10	7/6	Evered and Co., Ltd.	10	10—12
£100,000	Stk	5%	Ferranti, Ltd., 5% 1st Mort. Deb. Stock, Red.	100	90—95
25,000	10	5/-	Gen. Elect. Co. (1900), Ltd., 5% Cum. Pref.	10	9½—10
£200,000	Stk	4%	Do. 4% 1st. Mt. Deb. Stk., Red.	100	97—101
35,000	5	5/-	Henley's (W. T.) Telegraph Works Co., Ltd., Ord.	5	12—13
35,000	5	2/3	Do. 4½ Cum. Pref. ..	5	[illegible]
£50,000	Stk	4½%	Do. 4½% Mt. Deb. Stk. Red.	100	109—111
50,000	10	5/-	India Rubber, Gutta Percha & Telegraph Works Co., Ltd.,	10	[illegible]
£300,000	100	4%	Do. 1st Mort. Deb. Red. ..	100	[illegible]—102
7,500	10	[illegible]	Parker, Thos. Ltd. ..	10	6½—7
100,000	1	3%	Scott (Ernest) & Mountain, Ld., Ord.	1	16/3—16/9
37,350	12	12/-	Telegraph Construction and Maintenance Co., Ltd.	12	[illegible]
£150,000	100	4%	Do. 4% Deb. Bonds	100	102—104

III.—ELECTRIC TRACTION.

Present Amount Subscribed	Shares	Last Dividend	Name	Paid up	Closing Prices
120,500	5	[illegible]	Anglo-Argentine Trams Co., Ld., Or.	5	[illegible]
260,007	5	2/6	Do. 5% Cum. Pf.	5	[illegible]
£230,000	Stk	6%	Do. Permanent 6% Debenture Stock, 1888 ..	100	141—144
20,000	10	12/-	Barcelona Trams Co., Ltd., Ord. ..	10	[illegible]—11¼
10,000	10	5/-	Do. 5% Cum. Pf. Shares	10	9½—10
£46,300	100	5%	Do. 5% Debs., Red. ..	100	[illegible]—101
£1[illegible]	Stk	4½%	Do. 4½ Red. Deb. Stk.	100	97—102
75,606	1		Bath Elec. Trams. Ld., Pf. Or.	1	[illegible]
59,394	1	11 1d	Do. 5% Cum. Pf.	1	[illegible]
75,000	5		Brisbane Electric Tram Investment Co., Ltd., Ord. . .	5	1—1½
75,000	5	2/6	Do. 6% Cum. Pf.	5	[illegible]
£12[illegible],000	Stk	4½%	Do. 4½% 1st Deb. Stk., Red.	100	95—[illegible]
£200,000	Stk	6%	Brit. Columbia Elec. Rly. Co., Ltd., Def. Ord. Stock ..	100	[illegible]
		5%	Pref. Ord. Stock ..	100	104—107
133,301	10	6/-	Brit. Electric Traction, Ltd., Ord.	10	9—9½
156,437	10	6/-	Do. 6% Cum. Pref. ..	10	10½—11
£1,000,000	Stk	5%	Do. 5% Perp. Deb. Stk. ..	100	[illegible]
£250,000	Stk	4½%	Do. 4% 2nd Deb. Stk. Red..	100	[illegible]—101
100,000	5	2/6	Buenos Ayres & Belgrano Electric Trams, Ltd., Ord.	5	3½—4
40,500	5	3/-	Do. "A" 6% Cum Pref. ..	5	[illegible]
27,000	5	3/-	Do. "B" do.	5	[illegible]

ELECTRIC TRACTION.—*Contd.*

Present Amount Subscribed	Shares	Last Dividend	Name	Paid up	Closing Prices
£200,000	Stk	[illegible]	Buenos Ayres Elec. Trams Co. (1901) Ltd., 5% Db. Stk., Red.	100	[illegible]
£220,000	100	6%	Buenos Ayres Gd. Nat., Ltd., 6% 1st Deb. Bds	100	103—107
102,268	5	5/-	Calcutta Tramways Co., Ltd.		[illegible]
£350,000	Stk	4½	Do. 4½ 1st Deb. Stk., Red	100	[illegible]
480,000	1	6d.	Cape Electric Tramways, Ltd.	1	[illegible]
40,000	5	2/6	City of Birmingham Trams Co., Ltd. 5% Cum. Pref.	[illegible]	[illegible]
£300,000	100	4%	Do. 4% 1st Mort. Debs. ..	100	[illegible]
£120,000	Stk	5%	Colombo Elec. Tram. & Light. Co., Ltd., 5% 1st Mort. Deb. Stk. Red	100	103—105
60,000	10	6/-	Dublin United Trams. Co. (1896), Ltd., Ord. ..	10	[illegible]
59,987	10	6/-	Do. 6% Pref.	10	[illegible]
30,000	5	2/6	Isle of Thanet Elec. Trams. and Light. Co., Ltd., 5% Cum. Pref.	5	[illegible]
£150,000	Stk	4%	Do. 4% Deb. Stock..	100	[illegible]
125,000	10	5/-	London United Trams. (1901), Ltd., [illegible] Pref. .	10	[illegible]
£1,031,000	Stk	4%	Do. 4% 1st Mort. Deb. Stk. Red.	100	101—1[illegible]
£50,000	Stk	5%	Madras Electric Trams (1904), Ltd., 5% Deb. Stk., Red. .	100	103—105
314,016	1	—	Metropolitan Elec. Trams, Ltd., Def.	1	
500,000	1	6d.	Do. 5% Cum. Pref. .	1	1[illegible]
£350,000	Stk	4½	Do. 4½% Deb. Stock, Red.	100	[illegible]
50,000	5	6/-	New General Traction Co., Ltd., 6% Cum. Pref. ..	5	[illegible]
110,923	8	2/[illegible]	North Metropolitan Tramways Co..	8	[illegible]
£150,000	100	3½%	Do. 3½% Mort. Debs.	100	[illegible]
£196,200	Stk	5%	Perth Electric Trams, Ltd. (W.A.) 5% 1st Mort. Deb. Stock, Red..	100	[illegible]
24,500	10	10/-	Potteries Elec. Traction Co., Ld., Or.	10	[illegible]
24,500	10	5/-	Do. 5% Cum. Pref. ..	10	[illegible]
£220 000	Stk	4½	Do. 4½% Deb. Stk., Red.	100	101—104

IV.—ELECTRIC LIGHTING AND POWER.

Present Amount Subscribed	Shares	Last Dividend	Name	Paid up	Closing Prices
7,500	10	14/-	Bournemouth & Poole Elec. Sup. Co., Ltd., Ord. ..	10	[illegible]
7,500	10	4/6	Do. 4½% Cum. Pref. .	10	[illegible]
7,500	10	6/-	Do. 6% Cum. Second Pf. ..	10	11[illegible]
£70,000	Stk	4½%	Do. 4½% Deb. Stock Red ..	100	[illegible]
14,000	5	3/6	Bromley (Kent) Elec. Lt. & Pr. Co. Ld	5	
£50,000	Stk	4½	Do. do. 4½ 1st Deb. Stk. Red	100	104—[illegible]
27,507	5	4/6	Brompton & Kensington Elec. Supply Co., Ltd. Ord. ..	5	[illegible]
12,493	5	3/6	Do. 7% Cum. Pref. Shares..	[illegible]	[illegible]
60,000	5	5/-	Calcutta Elec. Sup. Cor. Ltd., Ord..	[illegible]	[illegible]
£288,782	Stk	4%	Central Elec. Sup. Co., Ltd., 4% Gua. Deb. Stk. ..	100	[illegible]
70,000	5	2/6	Charing Cross & Strand Elec. Sup. Corp., Ltd., Ord... ..	[illegible]	[illegible]
80,000	5	2/3	Do. do. 4½% Cum. Pref...	5	[illegible]
£3[illegible],000	Stk	4	Do. do. 4% Deb. Stk. Red.	[illegible]	[illegible]
11,436	5	2/3	Chelsea Elec. Sply. Co., Ltd., Ord.		[illegible]
£150,000	Stk	4½%	Do. do. 4½% Deb. Stk., Red	100	109—111
70,595	10	7/-	City of London El. Lghtg. Co., Ld., O.	10	11—11½
40,000	10	6/-	Do. 6% Cum. Pref.	10	[illegible]
£400,000	Stk	5%	Do. 5% Deb. Stk., Red ..	100	[illegible]
£300,000	Stk	4½	Do. 4½ [illegible] Deb. Stk. Red	100	104—106
40,000	10	[illegible]	County of London Elec. Sup. Co., Ltd., Ord.	10	[illegible]
30,000	10	6/-	Do. 6% Cum. Pf.	10	[illegible]
£400,000	Stk	4½%	Do. 4½% Deb. Stk., Red. ..	100	111—[illegible]
70,000	5	2/6	Edmundson's Elec. Cor. Ltd., Ord.	5	[illegible]
70,000	5	3/-	Do. 6% Cum. Pref. .	5	[illegible]
£300,000	Stk	4½	Do. 4½ [illegible] Deb. Stk. Red	100	[illegible]
£80,000	Stk	5	Electric Lighting & Traction Co. of Australia, Ltd. 5% Deb. Stk. Red.	100	[illegible]
19,000	5	6	[illegible] Supply Co., Ltd. O.		[illegible]
£50,000	Stk.	4½	Do. 4½ [illegible] Stk., Red.	100	[illegible]
15,000	10		Havana Elec. [illegible], Ltd. ..	10	[illegible]
13,000	[illegible]	5	[illegible], Ltd., Ord.		[illegible]
£50,000	Stk	4½	Isle of Wight Electric Light & Power Co., Ltd. 4½% Deb. Stock, Red.	100	100—103
150,000	1		Kal[illegible] Electric Power & Lighting Corp, Ltd., 6% Cum. Pref.	1	[illegible]
21,000	5	5/-	Ke[illegible] Electric Lighting Co., Ltd., Ord. .		[illegible]

Stocks and Shares marked [illegible] are quoted [illegible]

ELECTRIC LIGHTING AND POWER.—*Contd.*

Present Amount Subscribed	Shares	Last Dividend	Name	Paid up	Closing Prices
£135,000	Stk	4%	Kensington and Knightsbridge Electric Lighting Co., Ltd., and the Notting Hill Electric Lighting Co., Ltd., 4% Deb. Stock, Red.	100	102 —104
111,000	3	1/9	London Elec. Supply Corp., Ld., Ord.	3	2 — 2¼
60,000	5	3/-	Do. 6% Pref. ..	5	[illegible]
£371,895	Stk	4%	Do. 4% 1st Mort. Db. Stk. Red	100	99 — 102
100,000	1	[illegible]	Metropolitan Elec. Sup. Co., Ld., Or.	10	10½ — 11
76,121	5	2/3	Do. 4½% Cum. Pref.	5	[illegible]
220,000	Stk	4½%	Do. 4½% 1st Mort. Db. Sk. Red	100	109 —111
250,000	Stk	3½	Do. 3½% Mort. Deb Stk., Red	100	100 —102
£250,000		4½%	Midland Elec. Corp. for Power Distribution, Ld., 4½% 1st Mort. Deb.	100	100—102%
10,852	10	8/-	Notting Hill Elec. Ltg. Co. Ltd. Ord.	10	14 — 15
£59,000	100	4%	Do. 4% 1st Mort. Debs. ..	100	100 —102
16,500	5	2/6	Oxford Electric Co. Ltd., Ord.	5	6½ — 7
£50,000	Stk	4%	Do. 4% Debenture Stk. Red.	100	100—102
£84,700	100	4½%	Royal Elec. Co. (of Montreal) 4½% 20-yr. 1st Mort. Deb	100	101 —104
40,000	5	5%	St. James' & Pall Mall Elec. Light Co., Ltd. Ord.	5	14 — 15
20,000	5	3/6	Do. 7% Pref...	5	8 — 9
£150,000	Stk	3½%	Do. 3½% Deben Stock, Red	100	98 — 100
12,000	5	1/-	Smithfield Markets Elec. Supply Co., Ltd. Ord.	5	2¼ — 2¾
£50,000	Stk	4%	Do. 4% Debenture Stk Red.	100	76 — 80
65,000	5	1/-	South London Elec. Sup. Co., Ltd. O.	5	3½ — 4
100,000	1		South Metropolitan Elec. Light & Power Co., Ltd. Ord.	1	[illegible]
50,000	1	8½d.	Do. 7% Cum. Pref.	1	[illegible]
£100,000	Stk	4½%	Do. 4½% 1st Deb. Stock Red.	100	106 — 109
50,000	5	2/6	Urban Electric Supply Co., Ltd., O.	5	4¾ — 5
30,000	5	2/6	Do. 5% Cum. Pref.	5	[illegible]
£200,000	Stk	4½%	Do. 4½% 1st Mort. Deb Stk Red	100	105—107
110,000	5	6/6	Westminster Elec. Supply Corp. Ltd., Ord.	5	12¾ — 13¼
28,151	5	2/6	Do. 5% Cum. Pref. ..	5	[illegible]

V.—TELEGRAPH & TELEPHONE COMPANIES.

Present Amount Subscribed	Shares	Last Dividend	Name	Paid up	Closing Prices
£34,800	100	4%	African Direct Tel. Co., Ld., 4% Mt. Debs. (Series A), Red.	100	99 — 102
25,000	10		Amazon Telegraph Co., Ld... ..	10	3¼ — [illegible]
£763,580	Stk	14/-	Anglo-American Tel. Co., Ltd., Ord.	100	62 — 64
£3,118,210	Stk	28/-	Do. 6% Preferred Ordinary	100	108 —109
£3,118,210	Stk	2/-	Do. Deferred Ordinary ..	100	17½ — 17¾
14,000	5	5/	Chili Telephone Co., Ltd.	5	[illegible]
$15,000,000	$100	$2	Commercial Cable Co., Capital Stk.	$100	
£1,903,876	Stk	4%	Do. Sterl. 500-yr 4% Deb. Stk., Red.	100	98 —100
16,000	10	5/-	Cuba Submarine Tel. Co., Ld., Ord.	10	[illegible]
6,000	10	10/-	Do. 10% Preference	10	17½ — 18½
6,000	5	2/-	Direct Spanish Telegraph Co., Ord.	5	[illegible]
		5/-	10% Cum. Preference	5	9¼ — [illegible]
£30,000	50	4½%	Do. 4½% Debs.	50	100 — 103
60,710	20	4/-	Direct U.S. Cable Co., Ltd... ..	20	11⅞ — 12⅜
£85,800	100	4½%	Direct West India Cable Co., Ltd., 4½% Reg. Debs.	100	100—102
£300,000	100	4%	East. & S. African, Ld., 4% Mt. Dbs.	100	99½—101½
£200,000	25	4%	Do. 4% Rg. Mt. Dbs. (Mauritius Subsidy)..	25	101 — 103
300,000	10	2/6	Eastern Extension, Australasia and China, Ltd...	10	13¾—14¼
£602,400	Stk	4%	Do. 4% Mort. Deb. Stk., Perp.	100	106 — 108
£1,000,000	Stk	25/	Eastern Tele. Co., Ltd., Ord. ..	100	144 —147
£2,000,000	Stk	17/6	Do. 3½% Pref. .. .	100	[illegible]
£1,836,814	Stk	4%	Do. 4% Mort. Deb.	100	108 — 110
150,000	10	5/-	Great Northern Telegraph Co., Ltd., (of Copenhagen) ..	10	35 — 36
£58,700	100	4½%	Halifax and Bermudas Cable Co., Ltd., 4½% 1st. Mort. Debs. Red.	100	100—102
17,000	25	12/6	Indo European Tele. Co., Ltd.	25	[illegible]
72,680	1	7½d.	Monte Video Telephone Co., Ltd., O.	1	⅝ — ⅞
£1,983,393	Stk	6%	National Telephone Co., Ltd., Pref.	100	[illegible] — 113½
£1,966,667	Stk	5%	Do. Deferred ..	100	107—109
250,000	5	2/6	Do. 6% Non-Cum. 3rd Pref.	5	[illegible]
£2,000,000	Stk	3½%	Do. 3½% Deb. Stk., Red. ..	100	[illegible] — 101½
[illegible]	Stk	4%	Do. 4% do. do.	100	104 — 106
[illegible]	1	8d.	Oriental Telephone & Elec. Co., Ltd.	1	1½ — [illegible]
50,000	1	7⅕d.	Do. 6% Cum. Pref.	1	[illegible]
£100,000	100	4%	Pacific & European Tel. 4% Guar. Debs. Red...	100	100 — 103
11,839	8	4/-	Reuter's Telegram Co., Ltd.	8	[illegible]
58,000	5	3/-	United River Plate Telep. Co., Ltd.	5	7 — 7½
40,000	5	2/6	Do. 5% Cum. Pref.	5	[illegible]
£179,947	Stk	5%	Do. 5% Deb. Stock, Red. ..	100	109 — 111½
[illegible]	10		W. African Telegraph Co., Ltd. ..	10	10—10½
[illegible]	[illegible]		West Coast of America, Ltd.	[illegible]	[illegible]
150,000	100	4%	Do. 4% Deb. Guar. by West. Tel.	100	100—102

TELEGRAPHS AND TELEPHONES.—*Contd.*

Present Amount Subscribed	Shares	Last Dividend	Name	Paid up	Closing Prices
88,321	10	6d.	W. India & Panama Teleg Co., Ld., Or.	10	[illegible]
34,568	10	6/-	Do. 6% Cum. 1st. Pref. ..	10	[illegible]
4,669	10	6/-	Do. 6% Cum. 2nd Pref. ..	10	7 — 7½
£80,000	100	5%	Do. 5% Deb.	100	101 — 104
207,930	10	8/-	Western Telegraph Co., Ltd.	10	14 — 14½
£75,000	100	5%	Do. 5% Debs., 2nd Series, 1906	100	101 —103
518,915	Stk	4%	Do. 4% Deb. Stock, Red. .	100	102½ — 104½

VI.—SHIPPING COMPANIES.

Present Amount Subscribed	Shares	Last Dividend	Name	Paid up	Closing Prices
32,500	10	5/6	Anchor Line (Henderson Bros.), Ltd., 5½% Cum Pref.	10	9 — 9½
£325,000	Stk	4½%	Do. 4½% Red. 1st Mort. Deb. Stk.	100	101 — 103
£672,900	Stk	4½%	British & African Stm. Nav. (1900) Ltd., 4½% 1st Mort. Deb. Stk. Red	100	97 — [illegible]
19,000	10	5/6	Bucknall Steamship Lines, Ltd., 5½% Cum. Pref.	10	5¾ — 6¼
£600,000	Stk	4½%	Do. 4½% 1st Mort. Deb. Stk.	100	87 — 91
£750,000	Stk	4½%	Clan Line Steamers, Ltd., 4½% Deb. Stk. Red. ..	100	99 —101
60,000	20	16/-	Cunard Steam Ship Co., Ltd., Nos. 1-60,000..	20	[illegible]
40,000	20	8/-	Do. Nos. 60,001-100,000	10	5 — [illegible]
£461,430	Stk	4½%	Elder Dempster Shipping, Ltd., 4½% 1st Mort. Deb. Stk. ..	100	104—106
1,200,000	1	6d.	Furness, Withy & Co., Ltd., Ord...	1	1¼ — 1½
25,328	7½	4/7	Gen. Steam Navigation Co., Ld., Ord.	7½	[illegible]
36,758	8	4/9½	Do. Non Cum. 6% Pref	-	[illegible]
£150,000	Stk	4%	Do. 4% 1st Mort. Deb. Stk. Red.	100	98 —100
55,000	5	1/3	Houlder Line, Ltd., Ord. . .	5	2 — 2½
40,000	5	2/9	Do. 5½% Cum. Pref. ..	5	2¾ — [illegible]
£200,000	Stk	4½%	Do. 4½% 1st Mt. Deb. Stk. Red.	100	86 — 88
141,500	10	5/-	Leyland (Fredk.), & Co. (1900), Ltd., 5% Cum. Pref. ..	10	4 — 4½
£1,160,000	Stk	5%	Peninsular and Oriental Steam Nav. Co., 5% Cum. Pref. ..	100	129 —132
£1,160,000	Stk	19%	Do. do. Deferred	100	236 — [illegible]
15,000	100	30/-	Royal Mail Steam Packet Co. Ord..	60	[illegible]
39,075	5	2/6	Shaw, Savill & Albion, Ltd., 5% Cum. "A" Pref..	5	4½ — 5¼
39,075	5	2/6	Do "B" Ord. . . .	5	[illegible] — 4¼
141,841	10	4/-	Union Castle Mail Steamship Co., Ltd., Ord..	10	[illegible]
24,000	10	4/6	Do. 4½% Cum. Pref .	10	10½ — [illegible]
£1,008,894	Stk	4%	Do. 4% Debenture Stk., Red.	100	100 — 102

VII.—MISCELLANEOUS COMPANIES.

Present Amount Subscribed.	Shares	Last Dividend.	Name	Paid up.	Closing Prices
60,000	1	9⅜d.	Chadburn's (Ship) Tele. Ltd., Ord...	1	[illegible]
£750,000	Stk	5%	General Hydraulic Power Co., Ltd.	100	[illegible]
12,500	10	10/-	Oakey (John) and Sons, Ltd., Ord..	10	24 — 26
10,000	10	6/-	Do do. 6% Cum. Pf	10	14 — 15
183,538	1	6·3d.	Power Gas Corp., Ltd., Ord., Nos. 66,463-250 .	15/-	¾
66,462	1	8·4d.	Do. do. Nos. 1-66,462	1	[illegible]
135,000	1	6d.	Waygood (R.) & Co., Ltd., Ord. ..	1	1⅛ — 1¼
135,000	1	7⅕d.	Do. 6% Cum. Pref.	1	[illegible] — 1

RAILWAY CARRIAGE & WAGON COMPANIES.

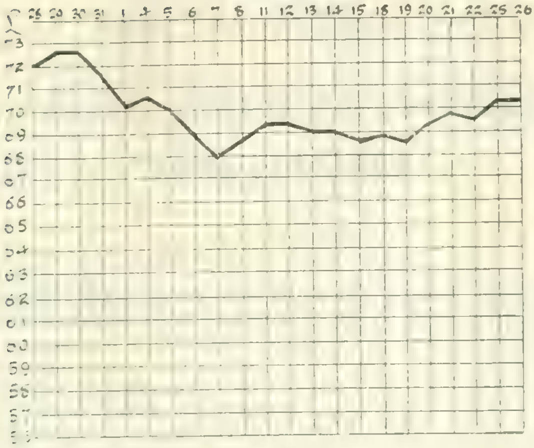
Present Amount Subscribed.	Shares	Last Dividend.	Name	Paid up.	Closing Prices
10,000	10	7/6	Birm. Railway-Car. & Wagon, L., 1-10,000	10	[illegible]
8,739	10	3/-	Do. Second Issue 1-8,739....	4	8¾ — 9¼
10,000	10	6/-	Do. Cum. Pref. 6% 1-10,000..	10	13¾—14
30,111	7	7/-	Gloucester Rail.-Car & Wagon, Ld., A, 1-29,861 & 49,751-50,000	7	9½— 10
44,889	7	3/6	Do. B, 29,862-49,750, 50,001-75,000	7	4 — 4½
11,567	10	1/3	Lancashire Wagon, Ord.	2	2 — [illegible]
4,150	10	5%	Do. do. . ..	10	[illegible]
784,808	1	9d.	Metropolitan Amalgamated Rail.-Carriage & Wagon, Ld., 1-784,808	1	44/ — 45/
164,288	1	6d.	Do. Cum. A Pref. 5% 1-164,288	1	[illegible] — 24/6
235,000	1	7½d.	Do. Cum. B Pref. 6% 1-235,000	1	28/6—29/-
20,000	20	20/-	Midland Rail.-Car. & Wagon, Ld., 1-20,000	10	[illegible]

[illegible] quoted ex dividend

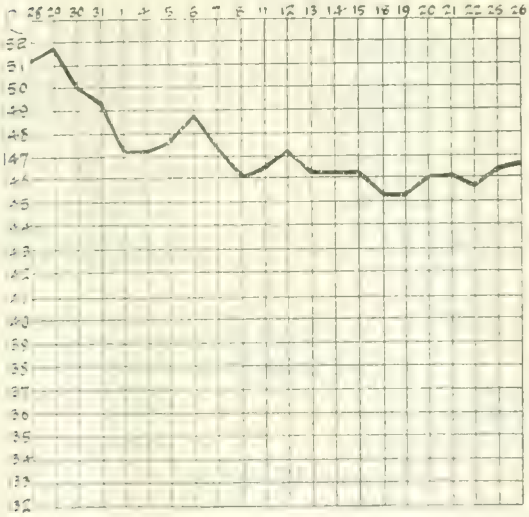
THE HOME METAL MARKET.

SHOWING DAILY FLUCTUATIONS FROM AUGUST 28TH TO SEPTEMBER 26TH, 1908.

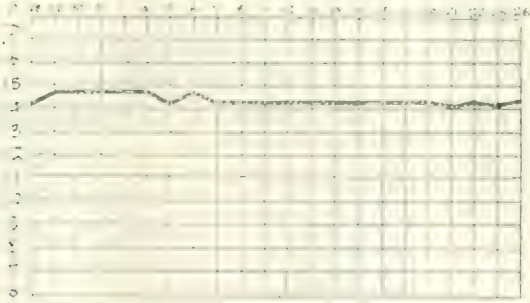
COPPER.



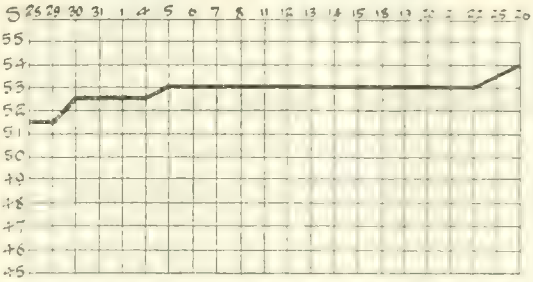
TIN.



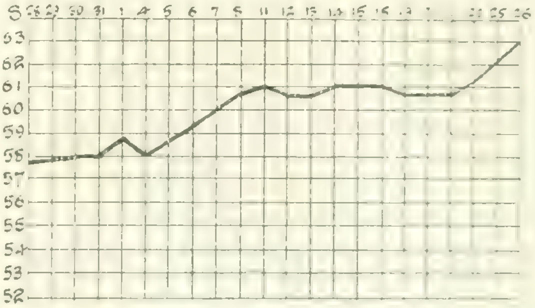
ENGLISH LEAD.



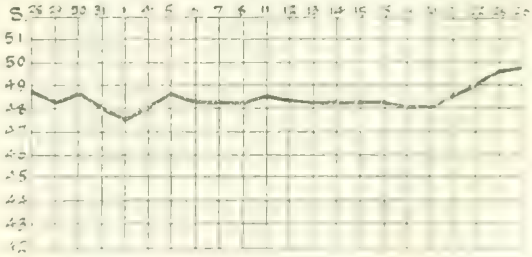
PIG IRON: SCOTCH.



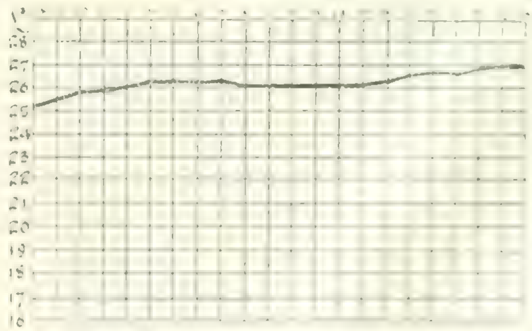
HEMATITE.



CLEVELAND.



SPELTER.



PRICES CURRENT OF COAL, IRON, STEEL, AND OTHER METALS.

MANUFACTURERS' AND MERCHANTS' QUOTATIONS.

MARKET REPORT.

Wednesday, September 27th, 1905.

THE Copper market, although firmer yesterday and having displayed considerable activity during the week, has exhibited some irregularity. Messrs. Henry Bath and Sons' report points out that bears who were recently so anxious to cover their open prompts have been inclined to make fresh sales, and at one time took values down to £68 cash. Intrinsically, one sees little or no change in the position of the metal, and there is still a lack of confirmation of the report that China is anxious to re-sell some of her recent purchases. During the past day or two standard warrants have received support, the market being helped by good statistics and the quotation has been carried up to £71 5s. od.

Tin has been an active market, and although large sales had again been made for forward delivery, the market has since rallied on speculative purchases, while some reduction of engagements on the part of the bear interest has assisted to hold up quotations. Yesterday some liberal offers for forward delivery caused a setback. The closing price was £146 17s. 6d. cash, and £145 15s. three months.

Lead has been somewhat easier on large arrivals, but the latest tendency is rather firmer with soft foreign prompt quoted at £14 2s. 6d., and English at £14 7s. 6d. Spelter has again advanced to a new record price of the year G.O.B. prompt being quoted at £27 buyers. The market appears to be practically bare, and there are active inquiries for forward delivery. Galvanised corrugated sheets have improved to £11 10s. f.o.b. and zinc sheets are firm.

The Iron market continues hard and active. Advices from Middlesbrough report that the boom has developed, and there are good inquiries for hematite both from the United States and the Continent. East Coast mixed numbers are brisk, a large quantity having been bought on American account. Cleveland iron is up 5s. as compared with two months ago, and hematite has advanced to 63s. Manufacturers of finished iron and steel have decided to make advances. Local reports indicate a strong tone, with active business in all departments. The output of half-manufactured Iron and Steel has undergone considerable improvement.

IRON, STEEL, PIG-IRON, &c.

SCOTLAND.

Messrs. David Colville and Sons, Ltd., Dalzell Steel and Iron Works, Motherwell, N.B., quote as follows. Prices delivered in Glasgow or equal.—

Steel:

		£	s.	d.
DALZELL	Siemens' Steel Plates, Marine Boiler Quality ..	6	15	0
♛♛	,, ,, ,, Land .. ,, ..	7	2	6
STEEL	,, Steel Bars, Boiler Quality ..	7	10	0
DALZELL	Siemens' Steel Plates, Ship Quality Plates .	6	10	0
♛	,, ,, Bars ,, ,, .	7	0	0
STEEL	,, ,, Angles	6	0	0

Manufactured Iron:

	£	s.	d.
Bars—Dalzell	6	5	0
,, Best	6	15	0
,, ,, Horseshoe ..	6	15	0
,, Angle..	6	5	0
,, Best Angle ...	6	15	0
,, Best Best	7	5	0
,, Extra Best	7	15	0

Usual terms and extras. Special rates for delivery in England and export. The above prices subject to alteration without notice.

The Glasgow Iron and Steel Co., Ltd., Wishaw quote as under (prices are delivered Glasgow or equal):—

(Glasgow ♛ Steel)	£	s.	d.	
Steel Angles	5	10	0	per ton.
Steel Ship Plates	5	17	6	,,
Steel Bars, Ship Quality	6	10	0	,,
Glasgow ♛ ♛ Steel.				
Steel Bars, Boiler Quality	7	0	0	,,
Steel Land Boiler Plates	6	7	6	,,
Steel Marine Boiler Plates	6	7	6	,,

Less 5 per cent. discount. Extras as per standard list.

Special prices for delivery in England and for export. The above prices subject to alteration without notice.

John Spencer (Coatbridge), Ltd., Phœnix Ironworks, Coatbridge, N.B., quote:—

	£	s.	d.
Bars—Phœnix	6	7	6
,, Best	6	17	6
,, Best Best	7	7	6
,, Extra Best..	7	17	6
,, Best Horse Shoe	6	17	6
,, Extra B.H.S.	7	17	6
,, Extra Best Cable	8	7	6
,, Rivet	6	7	6
,, Best Scrap Rivet	7	7	6

	£	s.	d.
Angles—Phœnix	6	5	0
,, Best	6	15	0
,, Extra Best	7	5	0
Gas Tube Hoops—Phœnix Best	6	15	0
Plates—Phœnix		—	
,, Best Boiler	7	10	0
,, Best Best Boiler	8	0	0
,, Extra Best Boiler	9	0	0
Boiler Tube Strips—Phœnix Best Best	8	0	0

All per ton, delivered f.a.s., Glasgow, Greenock, Grangemouth, Granton, Leith, or Ardrossan. 5 per cent. discount cash monthly.

Messrs. R. Feldtmann and Co., of Glasgow, quote Commission extra).

Pig Iron:	No. 1. £	s	d.	No. 3. £	s.	d.
Coltness, f.a.s. Glasgow		—		2	14	0
Gartsherrie ,,	2	18	6	2	14	6
Summerlee ,,	2	18	6	2	13	6
Carnbroe ,,	2	15	6	2	13	0
Langloan ,,	3	1	0	2	15	0
Calder ,,	2	18	6	2	13	6
Clyde ,,	2	18	6	2	13	0
Glengarnock, f.o.b. Ardrossan	2	18	0	2	13	0
Eglinton ,, ,,	2	14	6	2	12	0
Dalmellington, ,, Ayr		—		2	12	6
Shotts ,, Leith	2	18	6	2	14	0

NORTH OF ENGLAND.

Messrs. W. Whitwell and Co., Ltd., Thornaby Ironworks, Stockton, quote as follows, **at works:—**

	£	s.	d.
W.W. ♛ Bars	6	12	6
W.W. Best Bars	7	2	6
W.W. Best Best	7	12	6
W.W. Best Best Best	8	2	6
W.W. Best Shoe	7	2	6
Thornaby ♛	8	2	6
Thornaby Best	8	12	6
Thornaby Best Best	9	12	6
Whitwell Special Admiralty Cable	10	5	0
Special Chain Iron	9	5	0
Tube and Nail Strips	6	15	0
W.W. ♛ Angle Iron	6	15	0
W.W. Best Angle Iron	7	5	0
Tee Iron, to 8 inches United	7	12	6

Terms, Cash, less 2½ per cent. discount on 10th of month following delivery.

LANCASHIRE.

The Pearson and Knowles Coal and Iron Company, Ltd. Dallam and Bewsey Forges, Warrington, quote:—

		Iron. £	s	d.	Steel. £	s.	d.
♛	Bars	6	15	0	7	0	0
	Angles	7	5	0	7	10	0
(BNF)	Tees	7	15	0	8	0	0
♛	Hoops	7	0	0	7	10	0
W.I.W	Sheets	8	0	0	8	5	0

Ordinary Sizes, F.A.S. Liverpool in 10-ton Lots.

Extras for Sizes and Cutting as per List

WORCESTERSHIRE.

Baldwins Ltd. (with which is amalgamated Knight and Crowther, Ltd.), Wilden Works, near Stourport, quote:—

Black Sheets	Singles 20 G 96in. by 36in. per ton. £	s.	d.	Doubles 21 G to 24 G 96in. by 36in per ton. £	s.	d.
"Vale"	10	0	0	10	10	0
"Shield"	10	10	0	11	10	0
"Severn"	11	10	0	12	10	0
"Baldwin Wilden B."	12	10	0	13	10	0
Charcoal	16	10	0	17	10	0
Best Charcoal	18	10	0	19	10	0

Pickled, cold-rolled and close annealed sheets specially quoted for.

Extra widths, Singles to 66in., Doubles to 56in., Lattens to 46in. Extra lengths, Singles to 168in., Doubles to 132in., Lattens to 108in.

Patent Coated Sheets:

	£	s	d.	£	s.	
No. 3 Lead	13	10	0	14	10	0
S.V. Lead	15	0	0	16	0	0
No. 3 Terne	15	0	0	16	0	0
S.V. Terne	16	10	0	17	10	0

Tinned Sheets:	Singles 20 G to 108 by 36in. per ton. £	s.	d	Doubles 21 to 24 G to 96 by 36in. per ton. £	s.	d
Best Coke (Finish)	29	0	0	30	10	0
,, Charcoal (Finish)	31	0	0	32	10	0
Extra ,,	33	0	0	34	10	0

Cotton Can Tin Sheets to 39in. by 36in. specially quoted for.

Tin Plates, "Cookley, K" Best Charcoal, £1 7s. 0d. per box.

Extreme sizes in Tin and Patent Coated specially quoted for.

Lattens up to 36 wide by 27 W.G. £1 10s. 0d. per ton extra throughout for all brands.

At works.

Galvanized Corrugated Sheets:

	£	s.	d.	
"Phœnix" Brand, 24 G., f.o.b. London, in Bundles	12	15	0	per ton.
"Blackwall" Brand, 26 G., in felt-lined cases for Australia, f.o.b. London	14	15	0	

Galvanized Working Up-Sheets:

	£	s.	d	
24 G., f.o.b. London, in Bundles	13	10	0	per ton.

STAFFORDSHIRE.

Shelton Iron, Steel, and Coal Co., Ltd., Stoke-on-Trent, North Staffordshire, and 122, Cannon Street, London, quote:—

	£	s.	d.	
Crown Bars	6	10	0	per ton.
Best Bars (1 to 6in. wide, above ¼ in. thick, ½ in. to 4 rounds and squares)	7	0	0	,,
Angles	6	15	0	,,
,, Best	7	5	0	,,
Tees	7	0	0	
,, Best	7	10	0	
Best Shoe Iron	8	0	0	
,, Rivet Iron	8	0	0	
,, Best Rivet (Special)	9	5	0	
,, Cable	9	5	0	
,, Screwing	8	5	0	

	£	s.	d	
Best Tinning	8	0	0	per ton.
,, Plating	8	5	0	,,
Best Best	9	5	0	,,
Treble Best	10	5	0	,,
Plates	7	10	0	,,
Best Plates	8	0	0	,,
,, Boiler Plates	8	10	0	,,
,, Best Boiler Plates	9	10	0	,,
Treble Best Boiler Plates	12	0	0	,,

Delivery f.o.b. Liverpool, Birkenhead or Manchester

WALES.

Cordes (Dos Works), Ltd., of Newport, Mon., quote "Star" brand patent wrought nails steel nails, &c.

Discounts—

45 per cent. off 1-inch to 3-inch strong rose and all fine rose and 6dy. and 8dy. pound.

40 per cent. off 3½ inch to 7-inch strong rose and 10dy. and 20dy. pound.

40 per cent. off all sharp-pointed nails.

Delivered in lots of 4 cwt. and upwards. Extra 2½ per cent. discount off the gross on two tons and upwards.

Steel rose, flat points, 5-inch to 7-inch basis:—

2 tons 9/9 per cwt.
4 cwt. lots and upwards 10/- per cwt. } d/d any Railway Station

Steel cut nails, 3-inch basis—

2 tons 8/6 per cwt.
4 cwt. lots 8/9 per cwt. } d/d any Railway Station.

Slit rods (iron) £7 10s. per ton, at works for 2-ton lots.

Messrs. Richard Thomas and Co., Ltd., of 33 and 35, Eastcheap, E.C. — Works: South Wales, Burry, Lydney, Lydbrook, and Cwmbwrla, quote.

Coke Tin-plates.	Per Box. f.o.b. Wales. £	s.	d.
C 18¾ by 14 124s. 110 lb. "BV"	0	12	4½
C 20 by 10 225s. 155 ,, "Jumbo"	0	17	4½
C 20 by 14 112s. 108 ,, "Lydbrook"	0	12	0
C 28 by 20 112s. 216 ,, "Lydbrook"	1	4	3

Charcoal Tinplates:

	£	s.	d.
C 20 by 14 112s 108 lb. "Allaway"	0	12	9

BELGIUM.

C. L. Faulkner, Suffolk House, Laurence Pountney Hill, London, E.C., quotes:—

Prices quoted are in £ stg. and per ton of 1,015 kos. (2,240 lb.) delivered free on board ANTWERP for approved quantities.

Steel:		£	s.	d	
Blooms	at	3	16	0	per ton.
Billets	at	3	18	0	,,
Sheet Bars	at	4	0	0	,,

Finished Steel:		£	s.	d	
Bars	at	5	0	0	per ton.
Angles	at	5	1	0	,,
Tees	at	5	5	0	,,
Joists	at	4	12	6	,,
Fencing Standards	at	5	3	0	,,
Shoeing Bars	at	5	5	0	,,
Tyre Bars	at	5	5	0	,,
Half-Round Bars	at	5	10	0	,,
Heavy Rails	at	5	5	0	,,
Light Rails	at	4	17	6	,,

Structural Steelwork:

Prices on application.

METALS.

Messrs. French and Smith, 147, Leadenhall Street, and 11, Oldhall Street, Liverpool, quote:—

TIN.

Tin:	£	s.	d		£	s.	d.	
English Ingots, f.o.b. Dis 1¼%, & 1%	147	0	0	to	147	10	0	per ton
English Bars, f.o.b. Dis. 1¼%, & 1%	148	0	0	to	148	10	0	,,
Straits G.M.B., cash Warehouse, Net	146	12	6	to	146	15	0	,,
Straits G.M.B., 3 months, Warehouse, Net	145	10	0	to	145	12	6	,,
Australian, Mt. Bischoff, Warehouse, Net	147	0	0	to	147	10	0	,,

COPPER

Copper:	£	s.	d.		£	s.	d.	
Standard G.M.B., cash Warehouse, Net	70	15	0	to	71	0	0	per ton.
Standard G.M.B., 3 months, Warehouse, Net	69	17	6	to	70	0	0	,,
English, Tough, Cake & Ingot, Warehouses, Net	75	0	0	to	75	10	0	,,
English, Best Select, Warehouse Net	75	0	0	to	75	10	0	,,
English, Sheets and Sheathing, f.o.b., Dis 2½%	83	0	0	to	84	0	0	,,
English, Sheets for India, f.o.b., Dis. 2½%	78	0	0	to	78	10	0	,,
Electro, Warehouse, Net	75	15	0	to	76	0	0	,,
Ore, ex. ship	0	13	6	to	0	14	6	per unit
Regulus, Matte and Precipitate, ex ship,	0	14	6	to	0	15	0	,,

YELLOW METAL.

Yellow Metal:	£	s.	d.	
Sheets, 4 by 4 feet for India f.o.b. Dis. 2½%	0	0	6¾	per lb
Sheathing ,, ,,	0	0	6⅞	,,

SPELTER.

	£	s.	d.		£	s.	d.	
Silesian outports, Net	26	15	0	to	27	0	0	per ton.
Blende of 50%, Net	6	15	0	to	7	7	6	,,
Calamine, Net	6	17	6	to	7	10	0	,,

LEAD

	£	s.	d.		£	s.	d	
English Pig, Warehouse, Dis. 2½%	14	7	6	to	14	10	0	per ton.
Spanish, ex ship, Dis. 2½%	13	17	6	to	14	0	0	,,
Lead Ore of 70%, Net	7	7	6	to	7	12	6	,,

ANTIMONY.

	£	s.	d.		£	s.	d.	
Star Regulus, f.o.b., Dis. 2½%	58	0	0	to	60	0	0	per ton.
Ore, 50%, ex ship, Dis. 2½%	15	10	0	to	16	0	0	,,
Crude, ex ship, Dis. 2½%	34	0	0	to	36	0	0	,,

QUICKSILVER.

	£	s.	d.	
Spanish, 75 lb., Warehouse, Net	7	5	0	per flask
Italian ,, ,, ,,	7	2	6	,,

COAL.

LEICESTERSHIRE.

The Nailstone Colliery Company, Leicester, quote. Price per Ton at Pit of 20 Cwt., with ½ Cwt. per Ton for wastage —

Upper Main Seam.

	s.	d.
Main Coal	6	0
Best Hard Steam (hand picked, as used by the Railway Companies)	5	6
Best Hard Steam Cobbles (made through 6 in. mesh, free from slack)	5	6
Fine Slack	1	0

Terms, net cash on 10th of month following delivery.

DERBYSHIRE.

The Manners Colliery Co., Ltd., of Ilkeston quote as follows, per ton at pit:

Kilburn Coal:

	s.	d.
Best London Brights	9	9
Large Nuts (1½ to 3½)	9	6
Small Nuts (¾ to 1½)	6	0
Rough Brights	6	0
Peas (⅜ to ¾)	5	0
Slack	3	6
Smudge	2	0

Low Main (or Tupton) Coal:

	s.	d.
Low Main Brights	7	6
,, ,, Nuts	7	3
Hards (Good Steam Coal)	8	0
Bakers' Nuts (1" to 2")	6	6
Slack	3	6

The Clay Cross Company's Collieries, Clay Cross, near Chesterfield, quote:—

	per ton at pit. s.	d.
Best Main Coal	10	6
Best Silkstone	10	0
Best House Coal	8	6
Best House Nuts	8	0
Treble Screened Cobbles	7	9
Best Cobbles	7	3

NOTTINGHAMSHIRE.

The Digby Colliery Co., Ltd., near Nottingham, quote per ton at pit:—

Digby Coal:

STEAM.	s.	d.
Best Hand Picked Hard	8	6
Steam Hard	7	3
Hard Nuts	6	6

Gedling Colliery.

HIGH HAZEL.	s.	d.
London Brights, 4 to 8 in. cube	9	6
Bright Cobbles (Hand Picked)	9	0
Large Nuts, 2 to 4 in. cube	8	0
Small Nuts, 1 to 2 in. cube	6	0
Pea Nuts ⅜ to 1 in. cube	5	0
STEAM.—TOP HARD		
Best Hard	8	6
Hard Steam	7	6
Cobbles	6	3

CHEMICALS.

Messrs. S. W. Royse and Co., Albert Square, Manchester, quote:

	£	s.	d.	
Acids: Oxalic	0	0	2½	per lb
Picric, Crystals	0	0	10	,,
Tartaric at Manchester	0	0	10¾	,,

	£	s.	d	
Acetate of Lime: Brown at Manchester net	8	10	0	per ton.
Grey ,,	11	15	0	,,
Alumina: Alum, Lump, loose	5	5	0	,,
,, ,, in casks	5	7	6	,,
,, Ground, in bags	5	15	0	,,
Sulphate of Alumina, 14%	4	10	0	,,
Ammonia: Carbonate	0	0	3[illegible]	per lb.
Muriate Grey f.o.b. Liverpool	24	0	0	per ton.
Sal-ammoniac, Lump, 1sts, deld. U.K.	42	0	0	,,
,, ,, 2nds, ,,	40	0	0	,,
Sulphate f.o.b. Liverpool	12	10	0	,,
Arsenic: Best White Powdered net	14	10	0	,,
Bleaching Powder, 35% ,,	4	7	6	,,
Borax: British Refined Crystal ,,	13	0	0	,,

Coal Tar Products:

	£	s.	d.	
Benzole, 50/90 % ,,	0	0	7	per gal
,, 90% ,,	0	0	6½	,,
Carbolic Acid Crystals, 34/35° C. ,,	0	0	5¾	per lb
,, ,, ,, 39/40° C. ,,	0	0	6⅛	,,
,, ,, Liquid, 97/99 % ,,	0	0	9	per gal.
,, ,, Crude, 62½% at 60° F. f.o.b. ,,	0	1	7½	,,
Creosote, ordinary good liquid ,,	0	0	1⅜	,,
Naphtha, Crude, 20 % at 120° C. ,,	0	0	3	,,
,, Solvent, 90% at 160° C. f.o.b ,,	0	0	9	,,
,, ,, 95 % at 160° C. ,, ,,	0	0	9½	,,
,, ,, 90 % at 190° C. ,, ,,	0	0	10½	,,
,, Rectified, flash point over 73° F. f.o.b. ,,	0	0	11	,,
,, Rectified, flash point over 100° F. f.o.b. ,,	0	1	0	,,
Naphthalene, all qualities.				
Pitch f.a.s. Manchester. ,,	1	7	6	per ton.
Copperas: Green, in bulk ,,	0	12	6	,,
,, barrels f.o.b. L'pool ,,	1	17	6	,,
Cake ,,	1	2	6	,,
Copper: Sulphate	22	0	0	,,
Cyanides: 98% minimum f.o.b. net	0	0	7½	per lb.
Lead: Acetate (Sugar) White, English	27	10	0	per ton.
,, ,, ,, Foreign c.i.f. U.K	23	15	0	,,
,, ,, Grey ,,	21	15	0	,,
,, ,, Brown at Manchester	17	0	0	,,
Nitrate	25	0	0	,,
Litharge, Flake	16	10	0	,,
,, Powder	17	0	0	,,
Red Lead, Genuine, c.i.f. London less 5 %	16	0	0	,,
White ,, ,, Dry ,, ,, ,,	17	0	0	,,
Naphtha (Wood): Miscible, 60 p [illegible]	0	2	6	per gal
Solvent	0	2	7	,,
Potash: Bichromate... delivered England	0	0	3	per lb
Carbonate, 90/92 % ... c.i.f Hull	18	0	0	per ton.
Caustic, 75/80 ,, ,,	20	5	0	,,
Chlorate net	0	0	3[illegible]	per lb
Montreal in Store, Liverpool	31	10	0	per ton.
Prussiate Yellow net	0	0	4½	per lb

	£	s.	d.	
Soda: Ash, Caustic, 48 %, Ordinary … net	5	5	0	per ton.
,, ,, ,, Refined…… ,,	6	5	0	,,
,, Carbonated, 48 %………… ,,	5	10	0	,,
,, ,, 58 % (Ammonia Alkali) ……………… ..net	4	10	0	,,
,, Bleachers' Refined Caustic 50/52 % … net	6	10	0	,,
Caustic, White, 77 % …… ,,	10	12	6	,,
,, ,, 70 %…… ,,	9	12	6	,,
,, ,, 60 %…… ,,	8	12	6	,,
,, Cream, 60 %…… ,,	8	10	0	,,
Crystals, in bags ……………………	3	0	0	,,
,, barrels	3	7	6	,,
Acetate ……………… c.i.f. Hull net	16	10	0	,,
Bicarbonate, in 1 cwt. kegs	6	15	0	,,
Bichromate delivered England	0	0	2¼	per lb.
Chlorate …… …… net	0	0	3¼	per lb
Nitrate ex quay Liverpool, … ,,	10	10	0	per ton.
Phosphate ……………………	9	5	0	,,
Prussiate ……………………net	0	0	3½	per lb.
Silicate, Solution, 140° Tw. … …	4	10	0	per ton.
Sulphate (Glauber Salts)……………	1	10	0	,,
,, (Saltcake, 95%)…………	1	15	0	,,
Sulphur: Recovered …………	4	15	0	,,
Roll ……………………	6	15	0	,,
Flowers …………	7	10	0	,,
Zinc: Sulphate …………	6	15	0	,,
Shellac: Standard TN orange spot………	9	0	0	per cwt.

MINERALS.

Messrs. S. W. Royse and Co., quote:—

	£	s.	d.	
Barytes: Lump Carbonate, 90/92% ……	3	10	0	per ton.
Sulphate, No. 1, White…………	2	15	0	,,
China Clay: of various qualities for all purposes; prices from about 11/- to about 30/- per ton, f.o.b. Cornwall: stocks also kept at Runcorn and Preston. Quotations given carriage paid.				
Chrome Ore: Basis 50% c.i.f. British Ports………	3	10	0	,,
Manganese: Lump c.i.f. Liverpool 10¼d. per metallic unit.				
Ochre: French JC ……… f.o.b. Rouen, net	2	5	0	per ton.
,, JF ……………………………	5	10	0	,,
Talc: (French Chalk)………c.i.f. Liverpool	3	10	0	,,

Messrs. Henry Bath and Son, quote:—

	£	s.	d.		£	s.	d.	
Copper, Ores of, 10 to 25%.	0	12	0	to	0	13	0	per unit.
Regulus, 45 to 55%…….	0	13	3	to	0	13	9	,,
Precipitate, 65 to 80% …	0	13	4½	to	0	13	10½	,,
Tin Ores, 70 %………………	91	0	0	to	93	0	0	per ton
Lead Ore, 70% ……………					6	19	0	,,
Blende, 50% ……………					6	9	6	,,
Calamine………………					6	12	0	,,
Antimony Ore, 50%……	20	0	0	to	22	0	0	,, nom.

Messrs. Barrington and Holt, Cartagena, quote:—

Iron Ore

			s.	d.	
Ord. 50%, …………	f.o.b.	Porman ……………	6	4	per ton.
Do ……………	,,	Cartagena ……	6	7	,,
Special low phos.	,,	Porman ……	6	10	,,
Do. do.	,,	Cartagena…………	7	3	,,
Extra quality do.	,,	,, …………	7	6	,,
Special Iron Ore	,,	,, …………	nominal		,,
Specular 58%, do.	,,	………	10	0	,,

TIMBER.

Messrs. Alfred Dobell and Co., Liverpool, quote:—

COLONIAL WOODS.

Timber.

		£	s.	d.		£	s.	d.
Quebec Square White Pine…	per cub. ft.	0	1	9	to	0	3	3
Quebec Waney Board Pine…	,,	0	2	8		0	3	9
St. John Pine, 18 in. average	,,	0	2	4		0	3	3
Lower Ports Pine ……… ……	,,	0	1	3		0	1	8
Quebec Red Pine ………………	,,	0	1	6		0	2	3
Quebec Oak, 1st quality ……	,,	0	2	9		0	3	4
Quebec Oak, 2nd quality …	,,	0	1	6		0	2	6
Ash ……	,,	0	1	6		0	2	3
Elm ……	,,	0	3	3		0	4	0
Hickory ………………………	,,	0	2	0		0	2	6
Quebec Birch ………………	,,	0	1	6		0	2	3
St. John Birch ……	,,	0	1	6		0	2	0
Birch Planks……………………	,,	0	0	9		0	0	11
Spruce Spars ……	,,	0	0	10		0	1	0

Deals.

		£	s.	d.		£	s.	d.
1st quality Quebec Pine ……	per std.	22	10	0	to	32	10	0
2nd do. do.	,,	17	0	0		22	0	0
3rd do. do ……	,,	11	10	0		13	0	0
St. John, Miramichi, etc., Spruce … ………	,,	7	5	0		7	10	0
Nova Scotia Spruce.. .. ……	,,	7	2	6		7	7	6
Spruce Boards ……	,,	6	7	6		6	12	6

UNITED STATES, etc., WOODS.

Pitch Pine.

		£	s.	d.		£	s.	d.
Hewn ……	per cub. ft.	0	1	4	to	0	1	8
Sawn ……	,,	0	1	0		0	1	6
Planks, Stowage ……………	,,	0	0	10		0	1	0
Boards, Prime ………………	per std.	12	10	0		16	0	0
Oak Timber ……………	per cub. ft.	0	1	6		0	2	6
Oak Planks ……	,,	0	1	6		0	2	1
East India Teak……………	per load	12	0	0		16	0	0
Greenheart…… ………	,,	6	15	0		7	10	0

EUROPEAN WOODS.

Timber.

		£	s.	d.		£	s.	d
Riga Redwood ……………	per cub. ft.	0	1	6	to	0	2	0
Dantzic and Memel Fir, Crown …………	,,	0	2	1		0	2	6
Dantzic and Memel Fir, Middling …………	,,	0	1	9		0	1	11
Stettin ………………	,,	0	1	9		0	1	11
Swedish ………………………	,,	0	1	0		0	1	3
Riga Whitewood ………	,,	0	1	0		0	1	3
Norway Mining Timber … ..	,,	0	0	9		0	1	0
Dantzic and Stettin, etc., Oak………………	,,	0	2	6		0	3	0
Norway Spars ……	,,	0	1	2		0	1	9

Deals.

		£	s.	d.		£	s.	d.
Red Archangel and Onega, 1st quality …………………	per std.	19	0	0		20	0	0
Red Archangel and Onega, 2nd quality .. ……………	,,	14	0	0		16	0	0
Red Archangel and Onega, 3rd quality ………………	,,	10	10	0		12	10	0
St. Petersburg, 1st quality…	,,	16	0	0		17	10	0
Do. 2nd ,, …	,,	14	0	0		15	0	0
Gefle ……………	,,	11	10	0		16	0	0
Wyburg ………………………	,,	11	0	0		12	10	0
Uleaborg ……………………	,,	10	0	0		12	10	0
Gothenburg …………………	,,	11	0	0		16	0	0

OPENINGS FOR TRADE ABROAD.

Switzerland.

Tenders will shortly be considered at the offices of the Communal Administration, Coire, for the improvement and extension of the electric installation in that town, at the estimated cost of about £49,200.

Buenos Ayres.

There is a constant demand in this country for all classes of machinery connected with agriculture, including fencing wire, iron posts, windmills, pumps, elevators, and stone-working machinery.

Austria-Hungary.

It is announced that during the next three years the following sums are to be expended in Bohemia on improving its waterways: For making the river Moldau navigable in that part which flows through the city of Prague, £625,000; and for the continuation of the present work on the River Elbe, £600,000; of these sums £521,000 are available for work to be done in 1906.

Peru.

The British Vice-Consul at Arequipa reports that the Government of Peru have made an agreement with the Peruvian Corporation, Ltd., for the construction of a breakwater and dock at Mollendo to provide increased facilities for loading and discharging cargo from the lighters. The work is estimated to cost about £100,000, and will take about two years to complete.

France.

H.M. Consul at Lyons, in his recent report to the Foreign Office, states that a project is on foot to bring from Moutiers in Savoy the necessary electric power to drive the tramways in Lyons. The power it is proposed to transmit amounts to 6,300 h.p., which will be obtained from a waterfall 200 ft. high, a continuous high tension current being used. The transmitting cable will be 9 millims. copper wire, and the current will have a tension of 50,000 volts on arriving at Lyons.

Siberia.

The British Trade Commissioner in Siberia, in a recent report on that market, remarks that the most satisfactory way to extend business there in machinery, tools, and appliances would be for manufacturers to start combined stores, or representative agencies, in some of the chief town centres. These would act in the interest of several firms together, not competing one with the other, but sharing the expenses, and thus enlarging the exhibits. With stocks suitably selected, according to local requirements, more especially as regards tools of all descriptions and simpler mechanical contrivances, large business might gradually be developed. Much, too, might be done by sending out goods to existing firms to be sold on commission. Siberian firms in the machinery line are not extensive or wealthy establishments, and cannot always afford to purchase outright; but many of these Siberian firms state that they could sell machinery and tools if they had been thus obtained and exhibited. It is essential that the market conditions should be thoroughly studied and local wants taken into account.

Tunis.

H M. Consul-General at Tunis reports that the question of bringing Bizerta into closer active touch with the coast towns and agricultural region lying to its west has been continuously agitated in the last few years. According to the British Pro-Consul attached to the Consulate General three projects have been submitted to the Government: (1) A line to connect Nefzas, Beja and Mateur, to be undertaken by the Government and at their expense; (2) A line to connect Bizerta, Nefzas, Souk-el-Khemis and Nebeur, and to ultimately join the line (which will shortly be completed) between Pont du Fahs and Kef; (3) A line to connect Bizerta, Nefzas, Tabarca and La Calle

Russia.

The British Commercial Agent at Moscow states that the Special Commission of the Ministry of Ways, appointed to consider the question of the increase of the rolling stock of the Russian railways, has recommended for the present an immediate order of 8,800 new wagons (the word may mean passenger carriages or trucks), the works undertaking the order being obliged to deliver them not later than the beginning of next year. Orders for locomotives will, for the present, be limited to the full number that the works can turn out before the close of the present year. A Special Commission will meet on November 1st to consider the whole question of the insufficiency of rolling stock, especially noticeable at the present time. One of the causes of the insufficiency is the difficulty of the return of trucks dispatched from the European-Russian lines to Siberia. It is proposed in this connection to make use of the line now in course of construction from Viatka to Vologda, whence trucks can be dispatched either to Moscow or St. Petersburg, thus relieving the single line from Cheliabinsk to Samara, part of the present route to and from Siberia.

SELECTED PATENTS.

Compiled expressly for this Journal by **Messrs. Page and Rowlingson, Engineering Patent Agents, 28, New Bridge Street, London, E.C.,** and at Manchester.

Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton Buildings, Chancery Lane, W.C., at the uniform price of 8d.

NEW PATENTS APPLIED FOR.

When patents have been communicated the names of the communicators are printed in *italics.*

17703. Perry and Co. Ltd., and J. W. Bayliss, Birmingham. September 1st.—Improvements in, and in the manufacture or production of, lubricators.

17732. R. W. H. Rodney, Birmingham. September 1st.—Improvements in or relating to oil engines.

17753. H. Connell, Glasgow. September 2nd.—Pumps.

17757. T. Shepherd, Manchester. September 2nd.—Improvements in pedestal bearings and the like.

18331. T. Davis, London. September 11th.—Improvements in rotary engines.

18336. J. E. Moldon, London. September 11th.—Improvements in explosion engines.

18342. C. M. Manly, London. September 11th.—Improvements in variable speed gear.

18352. R. H. Nicholson, London. September 11th.—Improvements in automatic stop mechanism for steam engines.

18384. T. Grainger, Monmouthshire. September 12th.—An improvement in magnetic motors.

18386. W. Porritt, Lancashire. September 12th.—Improvements in the construction of steam generators for burning liquid or other fuels.

18395. J. Hannibal, London. September 12th.—Improvements in variable speed gearing for motor vehicles, velocipedes, or the like.

18407. E. F. Bradley, London. September 12th.—Improvements in carburettors for internal combustion engines.

18425. H. C. Lambert, London. September 12th.—An improved exhaust silencer for internal combustion engines.

18446. J. Fola, London. September 12th.—Improvements in or relating to propellers.

18448. The British Thomson-Houston Company, Ltd., London. September 12th.—Improvements in controlling means for automobiles.

18482. H. Paetow, Birmingham. September 13th.—Temperature regulated apparatus valve or the like.

18504. C. V. Kerr, London. September 13th.—Improvements in automatic governors for elastic fluid turbines.

18573. E. Buchholtz, London. September 14th.—Improvements in pumps.

18574. E. Buchholtz, London. September 14th.—A new or improved rotary propeller for ships and other vessels.

18590. W. Cassie, London. September 14th.—Improvements in internal combustion engines.

18592. H. T. Wright, London. September 14th.—Improvements in connection with turbines driven by power generated by internal combustion engines.

18628. W. R. Garside, London. September 15th.—Improvements in internal combustion engines.

18663. W. J. A. London, The Westinghouse Patent Bureau, London. September 15th.—Improvements relating to the balancing of fluid-pressure turbines.

18665. P. Smal, London. September 15th.—Improvements in and relating to hot-air turbines.

18676. O. Kolb, London. September 15th.—Improvements in apparatus for condensing steam.

18677. G. F. Steinbuch, London. September 15th.—Improvements in speed-change gear.

18688. J. L. Jefferson, London. September 15th.—Improvements in sight-feed lubricators.

18706. J. Batey, and A. Craig, Coventry. September 16th.—Improvements in carburetters.

RECENT SPECIFICATIONS.

IMPROVEMENTS IN AND RELATING TO INTERNAL COMBUSTION ENGINES.

Mather and Platt, Ltd., and A. E. L. Chorlton, Salford. August 24th, 1905.—This invention relates to improvements in and relating to internal combustion engines and is specially applicable to engines of the two-cycle type. It is well known that in engines as at present constructed, especially when of large size and working with combustible gases of high calorific value, difficulties occur owing to pre-ignitions in the combustion cylinder during the compression stroke, and the object of the present invention is to obviate such difficulties by mixing with the combustible gases a proportion of inert gas in the cylinder itself. Fig. 1 of the accompanying drawings is a vertical longitudinal section through the combustion cylinder of a double-acting two-cycle engine. Fig. 2 is a transverse section through the same. The combustion cylinder in which moves the piston, has exhaust ports which communicate with an exhaust exit situated at the middle. Opening into the cylinder are two ports, one towards either end, which as shown in fig. 1, place the two ends of the cylinder in communication with the by-pass and cooling arrangement. This cooling arrangement consists of pipes through which the gases pass surrounded by water either in communication with the general water cooling arrangements of the engine, or separately supplied and conveniently arranged at the top of the cylinder as shown in fig. 1, or towards the side as in fig. 2, or the by-pass and cooling arrangement may obviously be separated from the cylinder, but connected therewith by pipes opening from the ports. The ends of the piston are inclined or curved in such manner as to deflect the products of combustion escaping from either port into the middle of the charge in the cylinder. In the position shown in fig. 1 the piston is at mid-stroke supposed moving towards the left hand, in which case the ports being both open the gaseous products of combustion from the last explosion in the right-hand end of the cylinder will escape through the cooling arrangement, wherein their temperature is reduced, into the charge of mixed combustible gas and air in the left-hand end of the cylinder, thus reducing the activity of the combustible gas and at the same time increasing the degree of compression of the charge for the next explosion without the expenditure of additional power.

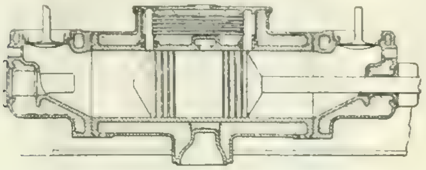


Fig 1

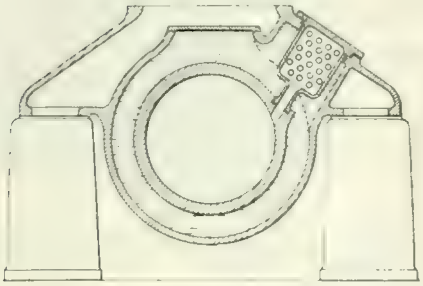


Fig 2

As the piston moves further towards the left, it closes the port into the cylinder seen on the right in fig. 2, and later opens port number two to the exhaust. On the return stroke towards the right after the next explosion, the piston, after closing the above last-mentioned port, will again open port number one and the products of combustion will then pass from the left-hand end of the cylinder to the right-hand end.

IMPROVEMENTS IN, AND RELATING TO, MECHANISM OR GEAR FOR FACILITATING THE APPLICATION OF AUTOMATIC EXPANSION APPARATUS OR TRIP CUT-OFF GEAR TO REVERSING ENGINES.

I. Storey and Sons, Ltd., Manchester, and T. Scott-King, Cardiff. August 24th, 1905.—This invention relates to mechanism or gear for facilitating the application and working of automatic expansion apparatus or trip cut-off gears in connection with reversing engines, and the object of the invention is to provide more simple and efficient means for this purpose, and consists also of applying the "Proell" automatic expansion apparatus and working such apparatus or gear by means of a single eccentric in connection with each gear and by link mechanism of the indicated type, said eccentric acting on the link mechanism so that the gear is controlled automatically in the running direction determined by the reversing gear. One form of link motion comprised in the invention consists in providing in connection with the valve rod an adjustable sleeve or boss, and formed in one with or connected with this sleeve is a bracket or support which has the motion imparted to it by the forward or backward eccentric, whichever happens to be in gear. Centred or hung upon said bracket is a pendant or other riding link, said riding link at its opposite end being suitably attached to an eccentric rod in connection with the substitute Proell eccentric. The motion for working the automatic expansion apparatus is taken from the rider link by means of a small link or other attachment secured thereto. The mechanism intermediate between the rider link and a shackle of the Proell automatic expansion apparatu may be varied for local circumstances or with different makes of engines, one way being to have the small link connected to the rider link jointed to a bell-crank pivoted lever which is in turn connected up by a rod to the shackle of a hanging arm. Although the invention is described in connection with the "Proell" automatic expansion apparatus, the invention may with or without slight modification be applicable in connection with another trip-cut-off gear as applied to reversing engines.

NEW PUBLICATIONS.

"SMOKE ABATEMENT."

A manual for the use of manufacturers, inspectors, medical officers of health, engineers and others. By William Nicholson. Charles Griffin and Co., Ltd. 6s. net.

The publication of this volume is well advised, and the author, who is the chief smoke inspector of Sheffield, is peculiarly fitted for the compilation of a work of this nature. His aim has been to consider the smoke question from a practical point of view, as it has to be faced daily by the engineer. The opening chapters deal with the legal aspects of the situation, and embody the enactments which from time to time have been made for the suppression of the smoke nuisance in England and abroad. The causes of smoke are next described, both from theoretical and practical standpoints, and the remedy indicated. Succeeding chapters discuss in detail the various appliances now on the market for the dual purpose of smoke abatement and fuel economy, the leading types being illustrated and described. In this connection it is interesting to note that the author thinks there is no cause for complaint of a scarcity of smoke-preventing and coal-saving appliances. He points out that there is now on the market almost every conceivable kind of apparatus to suit all conditions of working.

It is regrettable that the general attitude of the public towards this vital question is so apathetic, and according to Mr. Nicholson this apathy exists even in those circles where one would naturally expect an enthusiastic determination to overcome the nuisance. The pollution of the atmosphere by the unrestricted emission of smoke is a subject the importance of which it would be difficult to over-estimate, and we trust that the perusal of this convincing work will be the means of driving home upon the authorities at least one fact—that there is in existence sufficient legal machinery to enforce the prevention of this unnecessary evil.

TECHNICAL SOCIETY LITERATURE.

We have also received the following: "Transactions of the Mining Institute of Scotland," Vol. xxvii., Part 4. (Andrew Reid and Co., Ltd.) Contains the annual report of the council, Mr. Robert Thomas Moore's presidential address, and discussions on Mr. James Roden's paper on Coal-mining in Borneo, and Mr. E. O. Forster Brown's notes on the application of electric power to mines in Germany.—"The Journal of the West of Scotland Iron and Steel Institute." Vol. xii., Nos. 4 and 5. Among other matters discussed in these issues are economies of production, with special reference to iron and steel industries, and gas-blowing engines.—"Proceedings of the Incorporated Municipal Electrical Association, 1905." (Wyman and Sons, Ltd. 3s. 6d.) The contents of this volume embrace the presidential address of Mr. F. A. Newington, and interesting papers by Messrs. Alex. Sinclair, E. E. Hoadley, Hamilton Kilgour, William Hodgson, A. B Mountain, and A. R. Sillar.—"Transactions of the Australian Institute of Mining Engineers." Vol. x. Edited by A. S. Kenyon (Office of the Institute, Melbourne). The best production of its kind that we have seen for a considerable time, the printing and paper are excellent, while the illustrations are exceptionally good. The papers deal with the concentration of silver-lead ores, the career of the gold dredge in New South Wales, the transmission of power by compressed air in mines, phosphate deposit of Ocean and Pleasant Islands, etc.

NEW CATALOGUES.

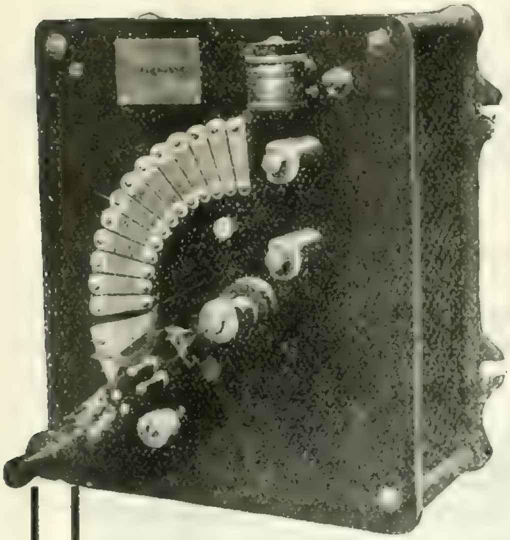
R. Y. Pickering and Co., Ltd., Wishaw near Glasgow and London.—Catalogue No. 3, E.F.S., has an attractive cover in grey and green tied with a silk cord. It illustrates a few of the many types of rolling stock made by the firm at their Wishaw Works, which, by the way, extend over 26 acres. In addition to railway carriages and wagons manufactured for various companies within the last year or two, the catalogue illustrates wheels and axles turned out for the Indian State Railways. The half-tone illustrations are of a high order and the text which is commendably brief and to the point, is furnished in three languages.

We have also received a well-printed catalogue which has been specially produced by this enterprising firm for their exhibit at the Liége Exhibition, printed in English, French and German, and illustrated with fine half-tone blocks.

J. Halden and Co., Manchester, London, etc. The firm's ingenious machine for continuous photo-copying as recently illustrated and described in Page's Weekly, finds a prominent place in a new pamphlet which has just come to hand. A number of other essentials for the drawing office are also described, including Halden's electric duplex radial copying frame, which copies two tracings at one exposure, a photo-print drying oven which dries six prints in the same number of minutes, a tilting semi-cylindrical electrical photo-copying frame, to copy a single tracing, architect's photo-copying apparatus, and Halden's patent photo-print squeegee. The latter will be welcome in the photo-room, not only because it facilitates the drying of prints, but also because it prevents water dripping on to the floor and promotes cleanliness.

Parker Boiler Company (Incorporated), Pennsylvania Building, Philadelphia, Pa. The economical principle to be followed in evaporating water into steam has been stated by Rankine as follows: "In a steam boiler it is favourable to economy of fuel that the motion of the water and steam should, on the whole, be opposite to that of the flame and hot gas of the furnace, in order that the hottest particles of each may be in communication with the hottest particles of the other, and that the minimum difference of temperature between the adjacent particles of the two may be the greatest possible. Thus, if there is a feed water heater consisting of a set of tubes through which the water passes to be heated before entering the boiler, that apparatus should be placed near the chimney. The coolest portions of the water in the boiler should, if practicable and convenient, be contiguous to the coolest part of the furnace, and if there is apparatus for superheating the steam, that apparatus will be most efficient if placed in the hottest part of the furnace." A very attractively printed pamphlet on the Parker boiler just to hand states that it is designed to meet these requirements and that practice has demonstrated the truth of the theory. The design is worked out on the lines of what is claimed to be the best water-tube practice, using straight tubes expanded into heaters of an improved form, and among many advantages detailed, we note that the first is the removal of scale from the tubes automatically while the boiler is in operation.

PAGE'S WEEKLY Miscellaneous



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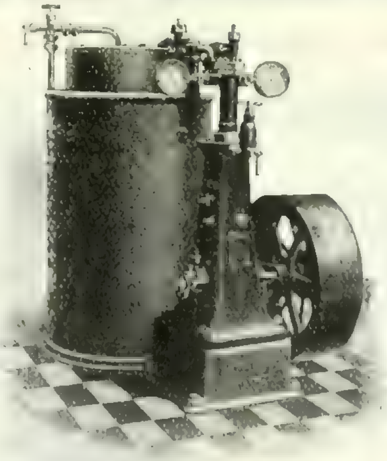

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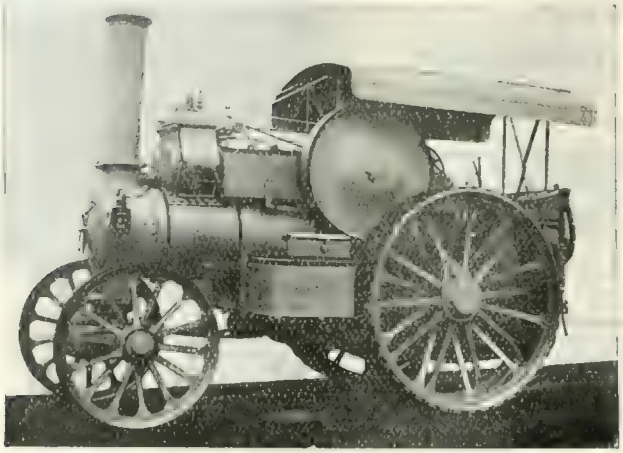

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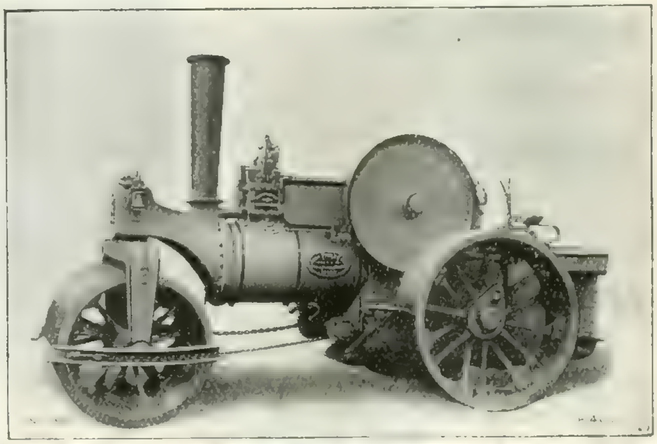

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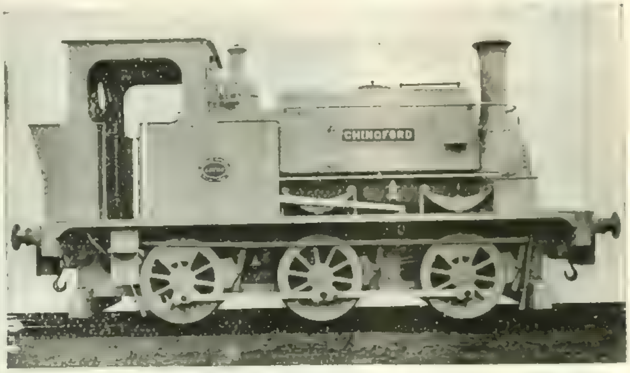

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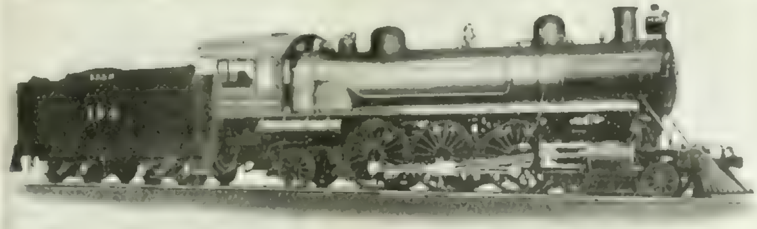

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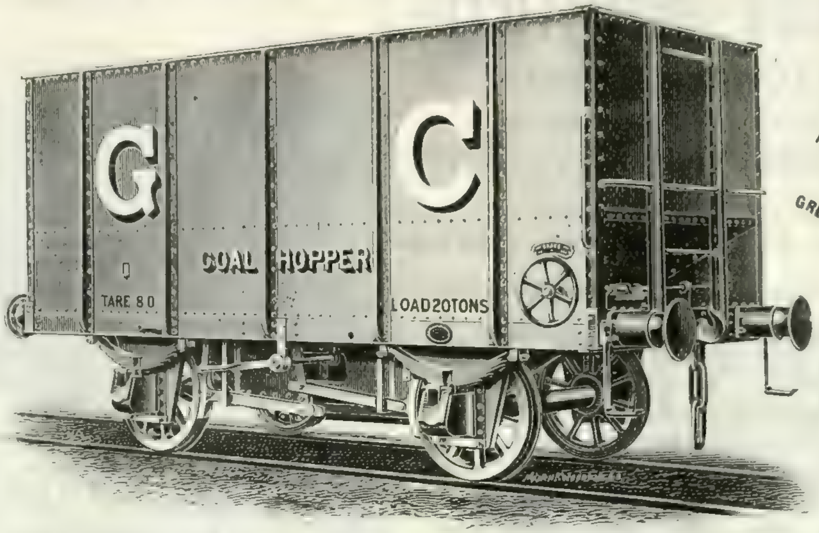

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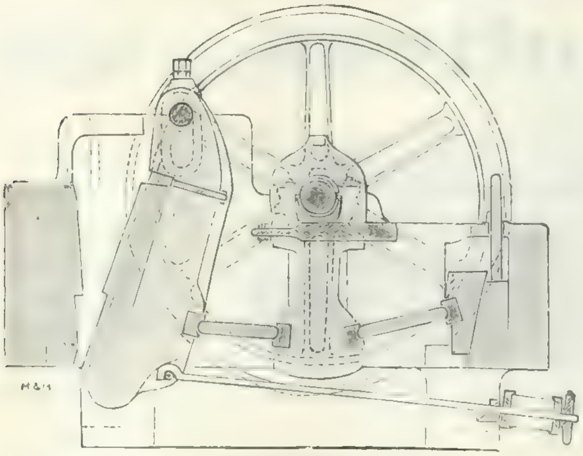

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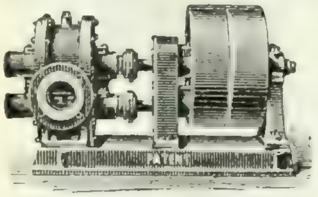

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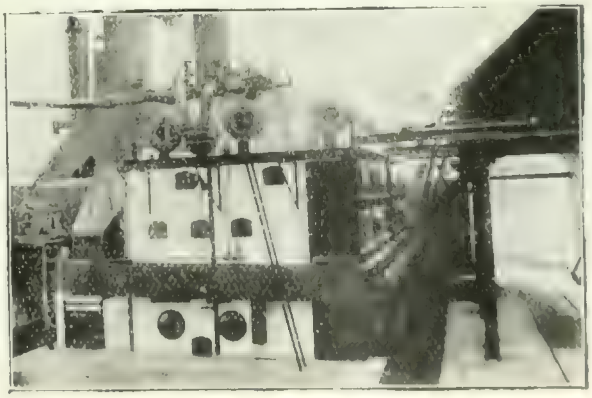

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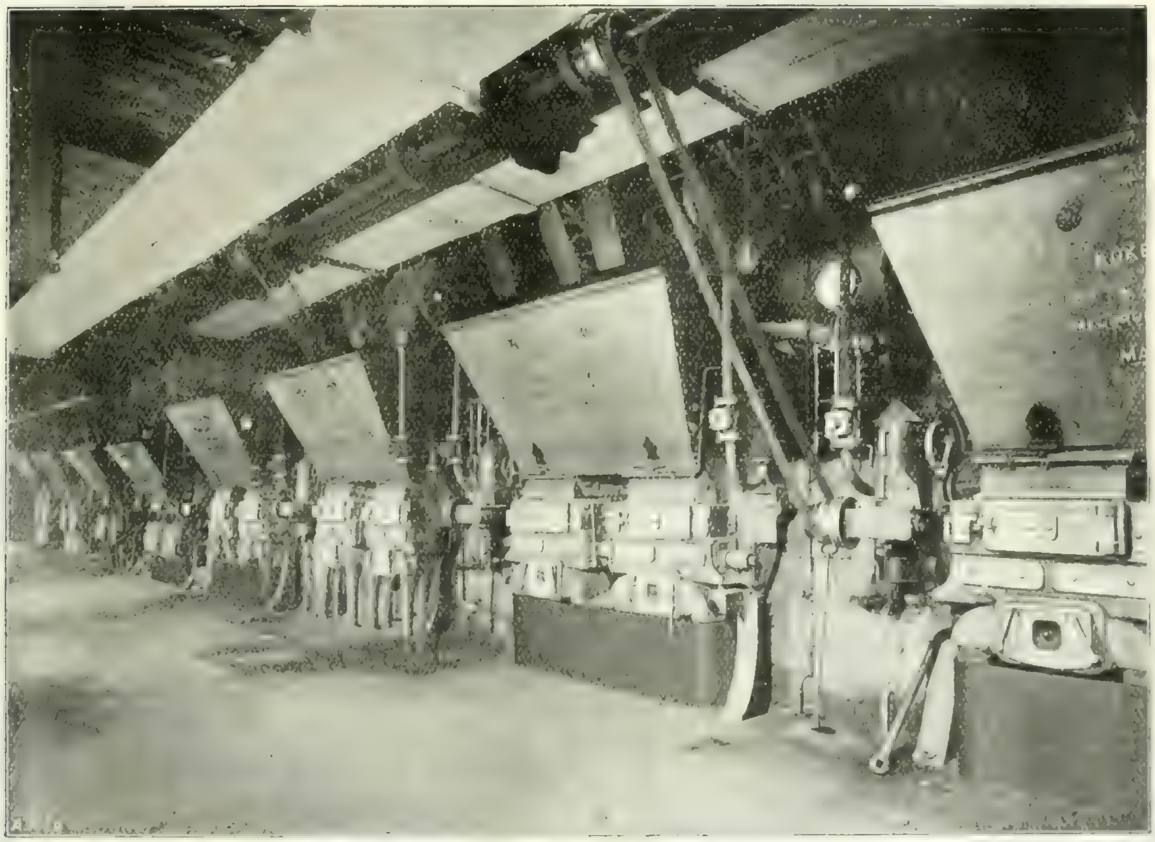

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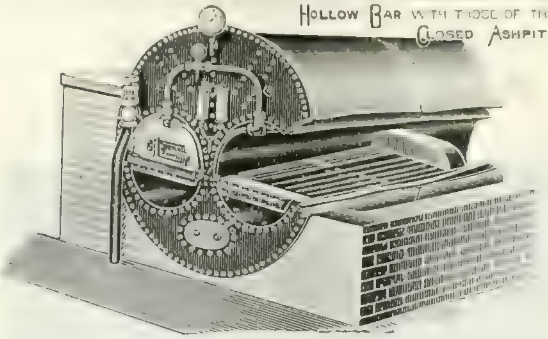

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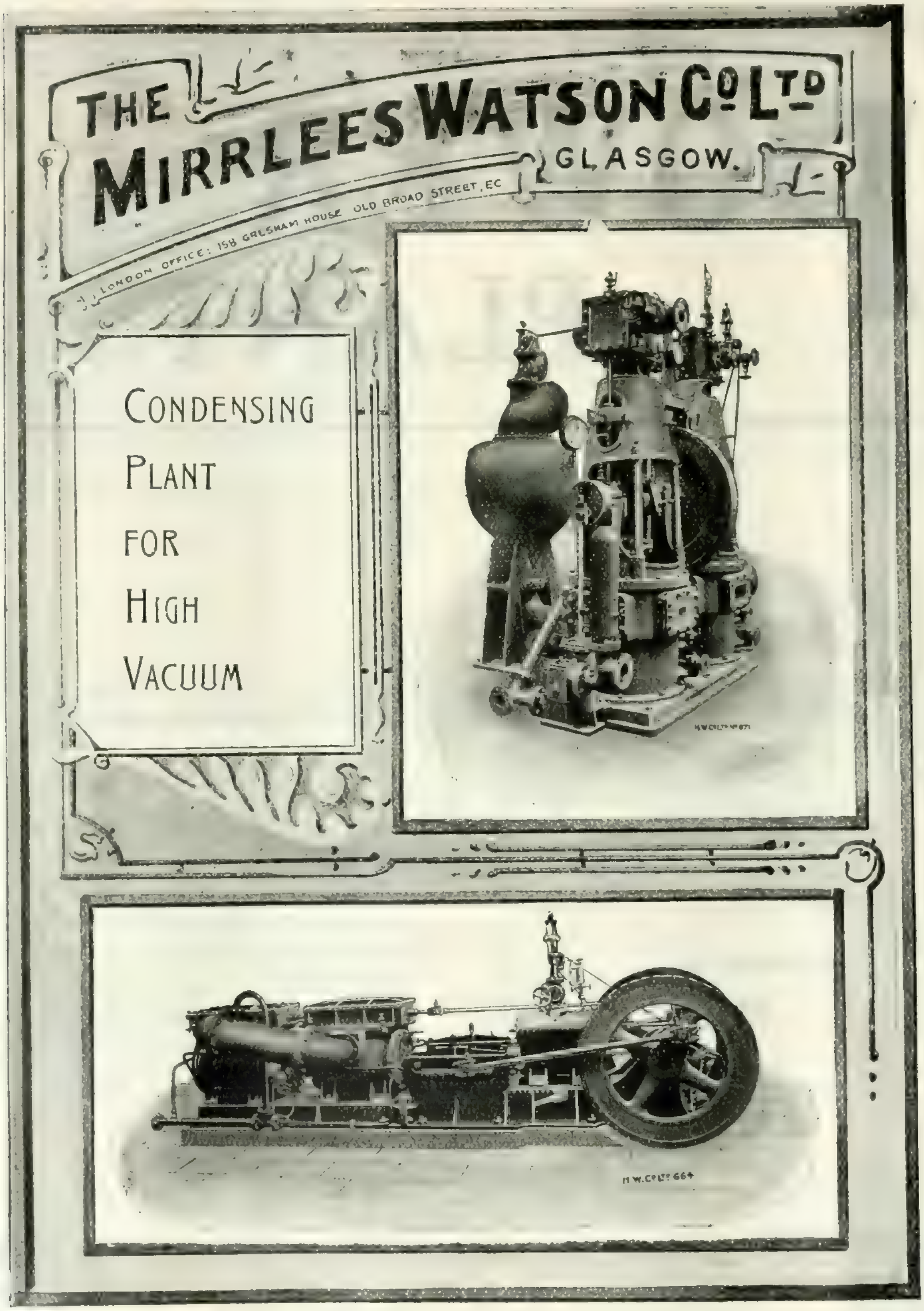

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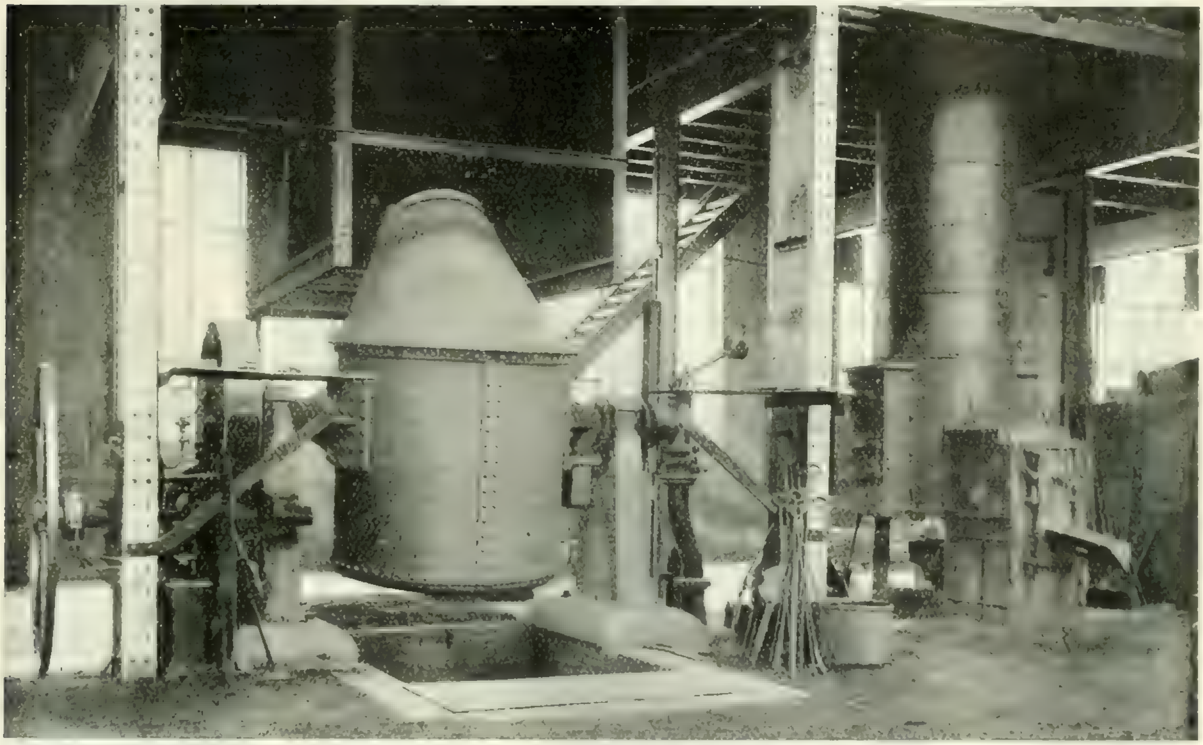

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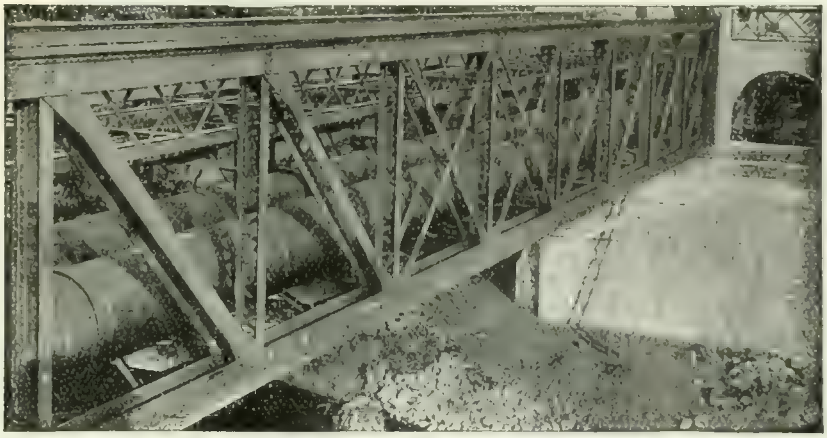

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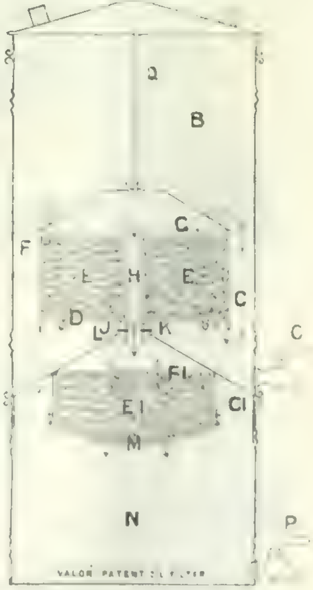

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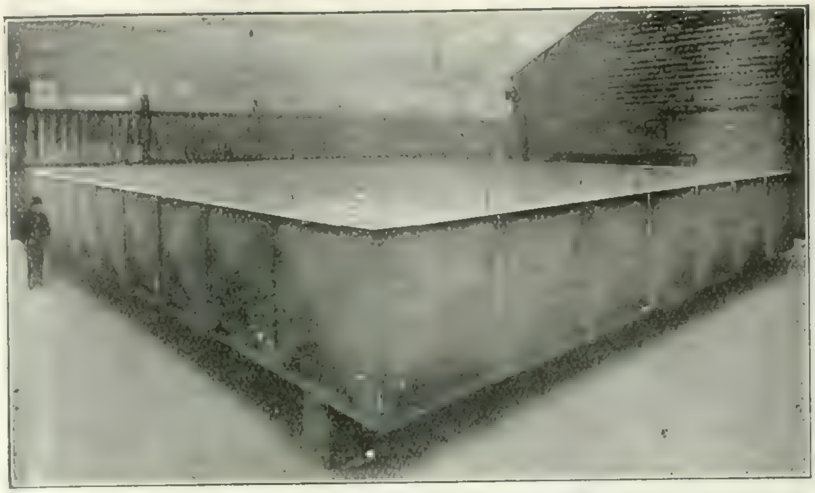

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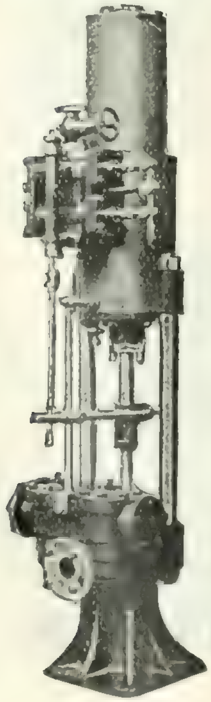

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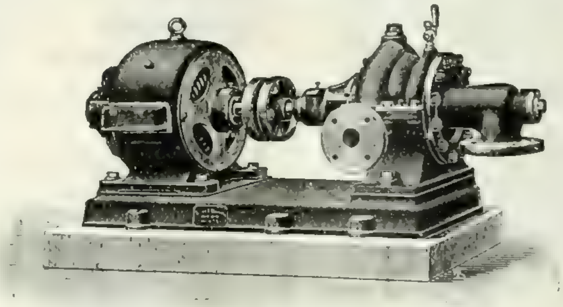

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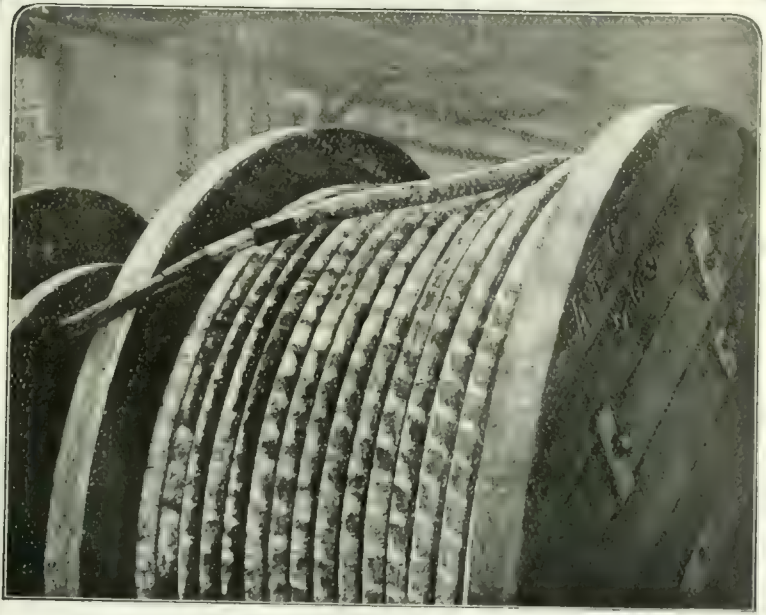

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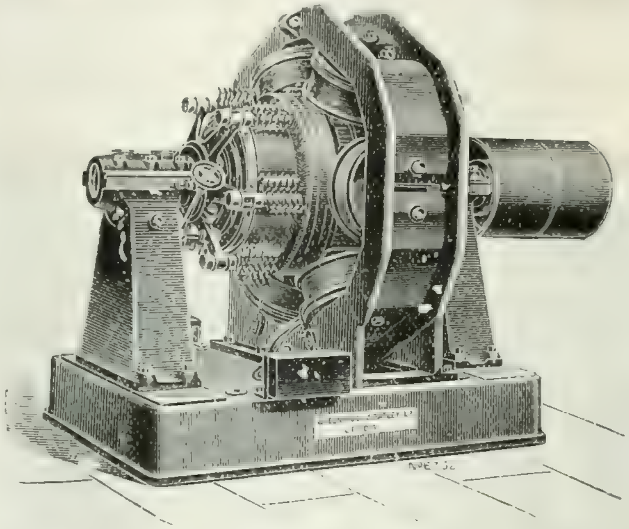

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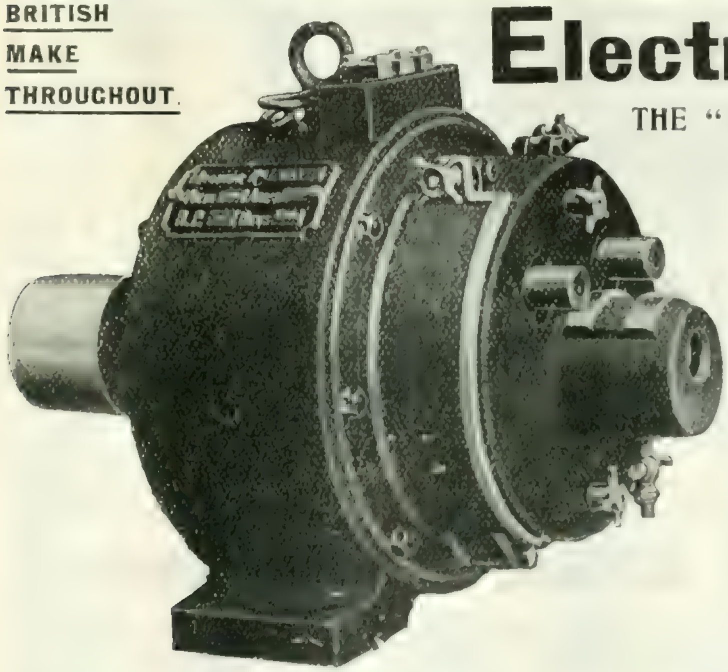

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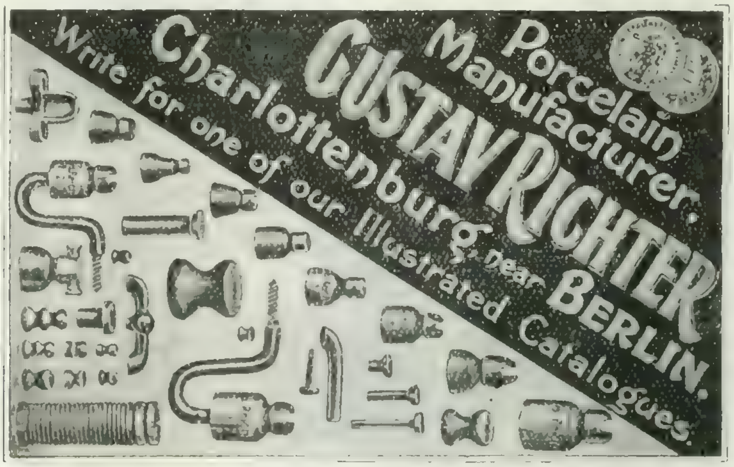
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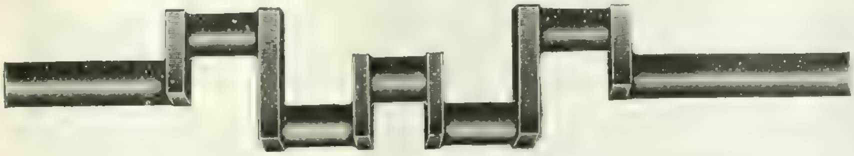

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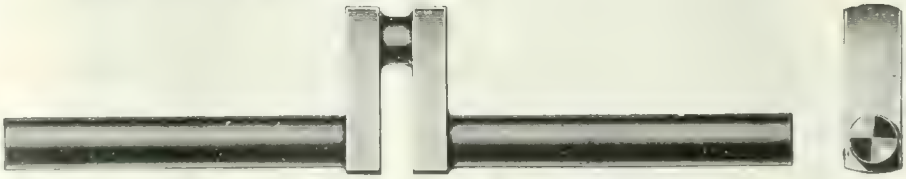

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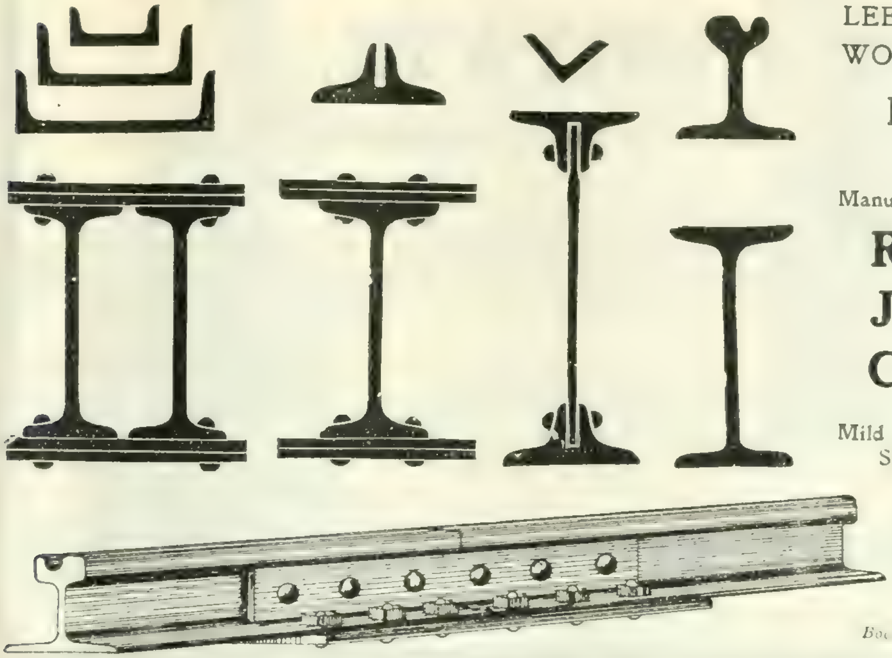

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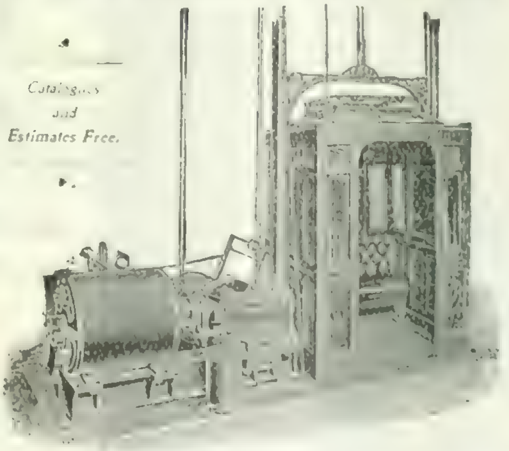

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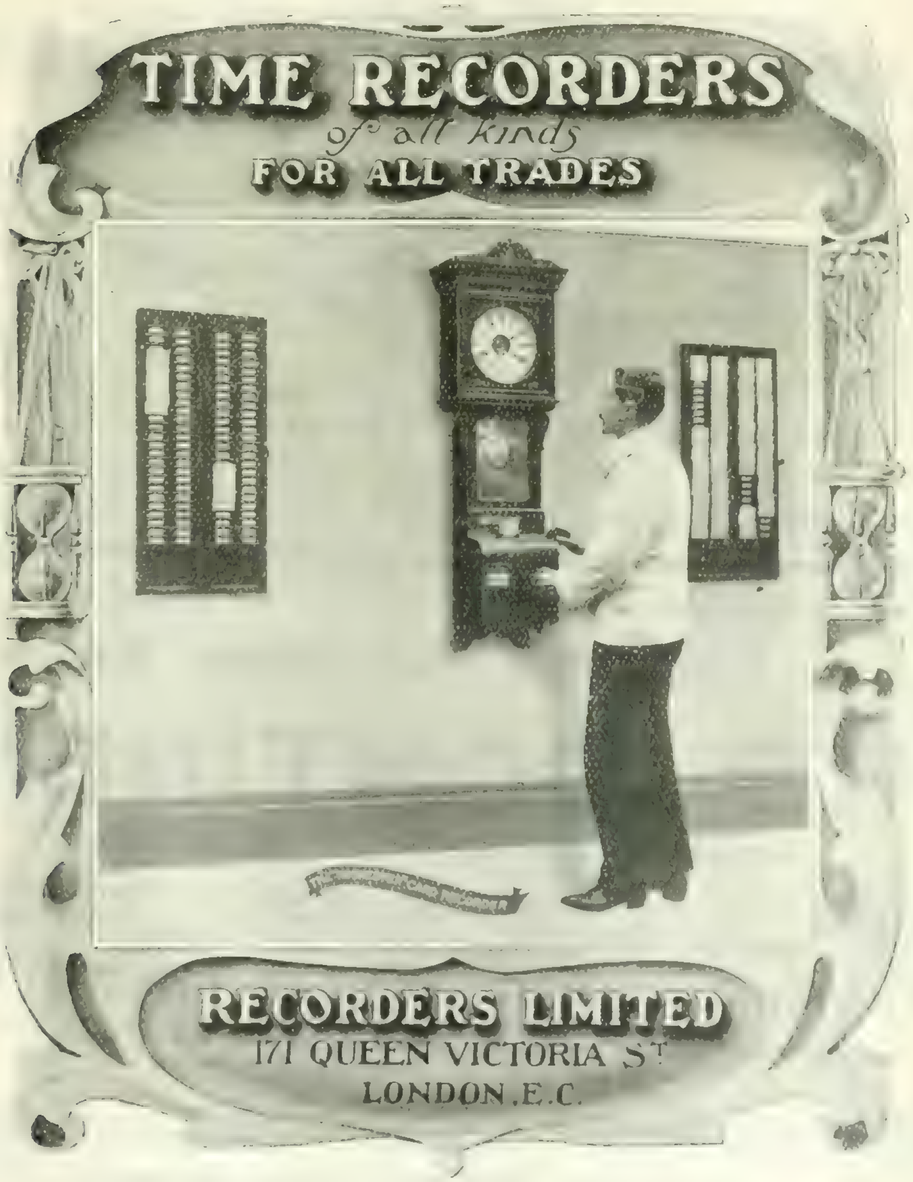

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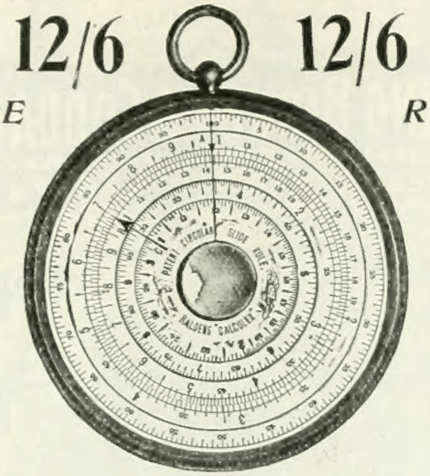

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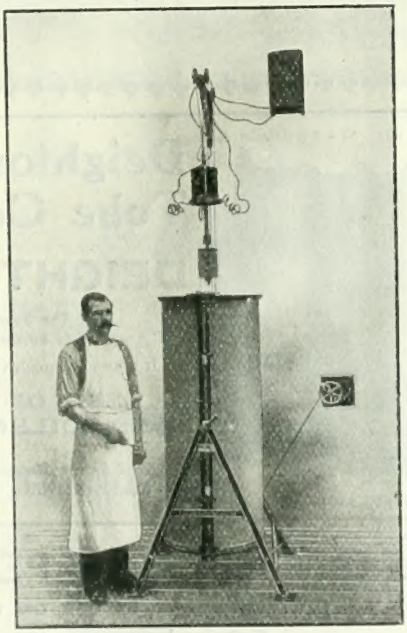

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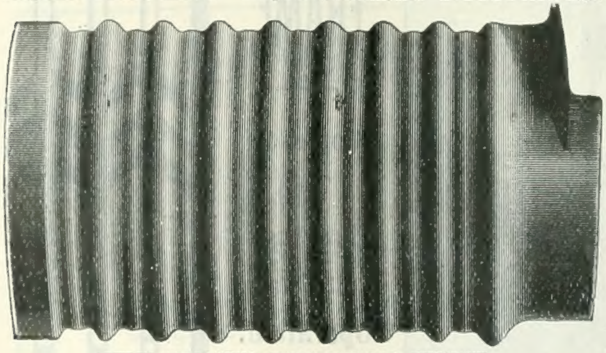

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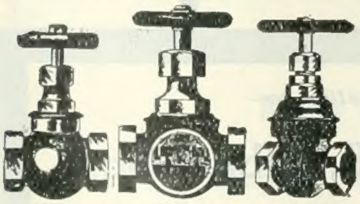

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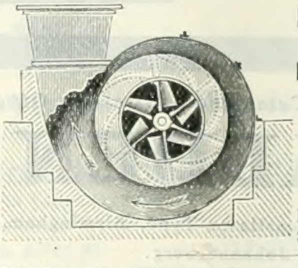

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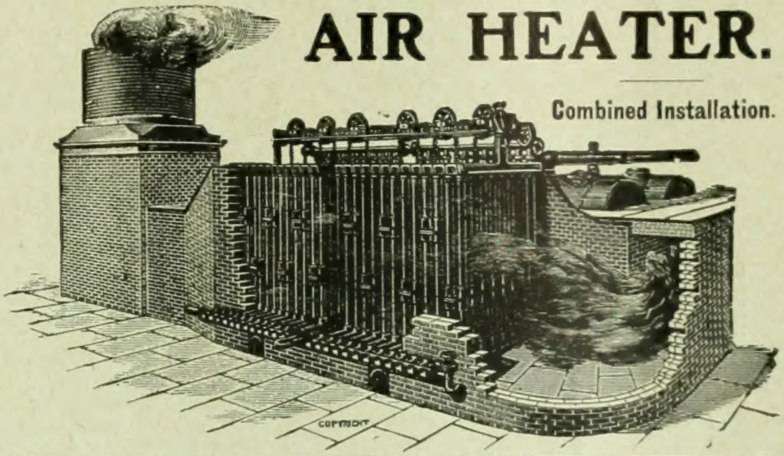

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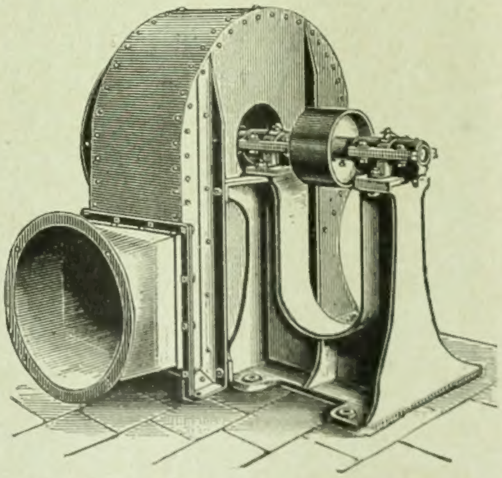

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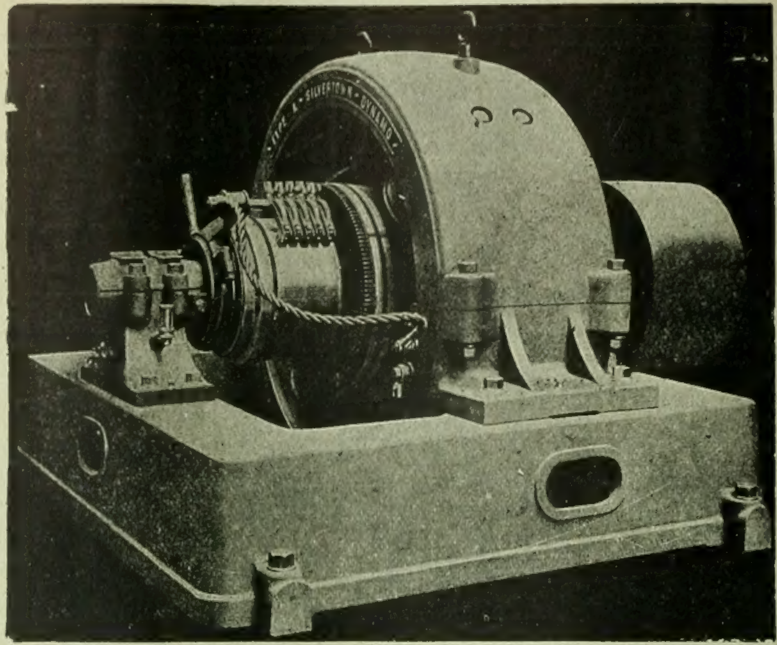

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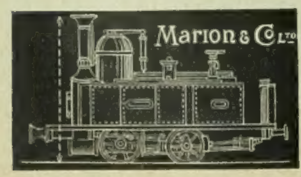

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